

# EXHIBIT 22

**UNITED STATES DISTRICT COURT  
DISTRICT OF PUERTO RICO**

In re:

THE FINANCIAL OVERSIGHT AND  
MANAGEMENT BOARD FOR PUERTO  
RICO,

as representative of

THE COMMONWEALTH OF PUERTO  
RICO, et al.

Debtors.

PROMESA TITLE III  
Case No. 17-BK-3283-LTS

(Jointly Administered)

In re:

THE FINANCIAL OVERSIGHT AND  
MANAGEMENT BOARD FOR PUERTO  
RICO,

as representative of

THE PUERTO RICO ELECTRIC POWER  
AUTHORITY,

Debtor.

PROMESA TITLE III  
Case No. 17-BK-4780-LTS

(Jointly Administered)

**This Court Filing Relates Only to PREPA  
and Shall be Filed Only in Case No. 17-  
BK-4780-LTS and Main Docket 17-BK-  
3283-LTS**

**EXPERT REPORT OF SEBASTIAN EDWARDS  
APRIL 28, 2023**

## TABLE OF CONTENTS

I.	INTRODUCTION .....	1
A.	Assignment .....	1
B.	Qualifications .....	2
II.	SUMMARY OF OPINIONS .....	4
III.	BACKGROUND .....	8
IV.	THE GNP PROJECTION UNDERLYING THE PLAN OF ADJUSTMENT IS FUNDAMENTALLY FLAWED AND BIASED DOWNWARD.....	9
A.	The Economic Outlook Model.....	10
1.	Construction of the GNP Trendline .....	13
2.	Structural Reforms .....	17
3.	Fiscal Policy.....	19
B.	The EOM Predicts an Unprecedented Recession Worse than Anything Observed in Modern History .....	23
C.	The EOM’s Modeling Framework is Unsuitable for Projecting Puerto Rico’s GNP, and its Inputs are Unreliable.....	27
1.	The EOM’s Regression-based Approach is Ill-Suited for Puerto Rico’s Long-Term Forecast.....	27
2.	The EOM Entirely Omits a Key Driver of Economic Growth: Labor.....	31
D.	The EOM Makes Multiple Unreasonably Pessimistic Assumptions.....	32
1.	The EOM Assumes a Declining Capital Stock.....	33
2.	There is No Basis for the EOM’s Assumption that Expected Infrastructure Reform Provides No Benefit .....	40
E.	Relevant Economic Indicators Strongly Suggest that Puerto Rico is well into Recovery from the Decline that Started in 2006.....	42
F.	The GNP Projection Underlying the Plan of Adjustment Fails to Account for Certain Growth-Generating Fiscal Policies Contained in the EOM.....	48
V.	A SOLOW GROWTH MODEL IS BETTER SUITED TO MODELING PUERTO RICO’S FUTURE GNP AND PREDICTS A HIGHER AND MORE REASONABLE FUTURE TRAJECTORY .....	50
A.	The Solow Growth Model Description.....	51
B.	The Solow Growth Model with Reasonable Assumptions Projects a Higher Future Path for Puerto Rico’s GNP .....	54
1.	SGM Specification.....	55
2.	SGM Parameters .....	56
3.	GNP Projection .....	66

VI.	AN UNJUSTIFIABLY LARGE HAIRCUT ON PREPA BONDS MAY HARM PREPA IN THE LONG RUN BY INCREASING ITS COST OF CAPITAL GOING FORWARD.....	69
A.	Unduly Large Debt Reductions Can Cause Reputational Damage and Impair Future Borrowing .....	69
B.	The Commonwealth’s Influence Over PREPA’s Policies May Impact Market Perceptions About the Ability to Recover Loans .....	73
VII.	THE COMMONWEALTH’S SUBSIDIZATION POLICIES CREATE MARKET DISTORTIONS WITH NEGATIVE CONSEQUENCES .....	74

## I. INTRODUCTION

### A. Assignment

1. I have been engaged to submit this report by Counsel for the Ad Hoc Group,<sup>1</sup> Syncora Guarantee, Inc., Assured Guaranty Corp., and Assured Guaranty Municipal Corp. (collectively, “Bondholders”) in connection with the Puerto Rico Electric Power Authority (“PREPA”) bankruptcy. I have been asked to evaluate certain methodologies, macroeconomic assumptions, and inputs that underlie the electricity load projections used in PREPA’s Plan of Adjustment (as defined below). These projections drive, in part, the amount of future revenues that the Financial Oversight and Management Board (“FOMB” or the “Board”) proposes to make available to fund creditor recoveries.

2. The FOMB’s proposed sum of revenues available for creditor recoveries uses, as an input, a projection of PREPA’s electricity demand (or “load”) that ties back to a load forecast in PREPA’s 2022 Certified PREPA Fiscal Plan. That load forecast, in turn, relies on macroeconomic projections in the 2022 Commonwealth Fiscal Plan certified by the FOMB.<sup>2</sup> I have not been asked to opine on any PREPA Fiscal Plan or Commonwealth Fiscal Plan, as such, but rather whether the projections underlying the Plan of Adjustment are reasonable and credible.

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<sup>1</sup> The AdHoc Group includes BlackRock Financial Management, Inc., Franklin Advisers, Inc., GoldenTree Asset Management LP, Invesco Advisers, Inc., Nuveen Asset Management, LLC, Taconic Capital Advisors L.P., and Whitebox Advisors LLC.

<sup>2</sup> See 2022 Certified Fiscal Plan for the Puerto Rico Electric Power Authority, dated June 28, 2022 (henceforth, “2022 PREPA Fiscal Plan”) and 2022 Fiscal Plan for Puerto Rico as Certified by the Financial Oversight and Management Board, dated January 27, 2022 (henceforth, “2022 Commonwealth Fiscal Plan”). I understand that, on April 3, 2023, the FOMB certified a new 2023 Fiscal Plan for Puerto Rico. Because the operative 2022 PREPA Fiscal Plan relies on the economic projections in the 2022 Commonwealth Fiscal Plan, I have at this time confined myself to an analysis of that plan. I reserve the right to consider future fiscal plans as necessary, including but not limited to in response to any new certified PREPA Fiscal Plan or any new or amended Plan of Adjustment that relies on it.

I also have been asked to review and evaluate, from an economic perspective, the effect of the Plan of Adjustment and certain PREPA subsidies on PREPA's future borrowing conditions.

## **B. Qualifications**

1. I am a Professor of Business Economics at the Anderson Graduate School of Management and the Henry Ford II Chair in International Management at the University of California, Los Angeles. I received a Ph.D. in economics from the University of Chicago in 1981, an M.A. in economics from the University of Chicago in 1978, and Licenciado Economica (Licentiate in Economics) and Ingeniero Comercial (Commercial Engineering) degrees from Universidad Catolica in Chile in 1975.

2. I am an expert in international debt markets, and have extensive experience related to government borrowing in developing, middle-income economies, and advanced economies. From 1993 to 1996, I was the Chief Economist for the Latin America and Caribbean Region at the World Bank. From 2001 to 2003, I was the President of the Latin American and Caribbean Economic Association. I have served as a consultant to many multinational institutions, including the International Monetary Fund, the World Bank, the Inter-American Development Bank, the Organization for Economic Cooperation and Development, and the U.S. Agency on International Development. I have also served as a consultant on economic issues, including issues related to sovereign debt, to several governments, including Costa Rica, Guatemala, Mexico, Argentina, Chile, Colombia, New Zealand, Iceland, Indonesia, Tanzania, and Nicaragua. These assignments began in the late 1980s and have continued until the present. Between 2012 and 2021, I was the Senior Associate Dean of Global Initiatives and Director of the Center for Global Management at

the Anderson Graduate School of Management. I am a Research Associate and served as Co-Director of the Africa Project at the National Bureau of Economic Research (“NBER”).

3. In my classes, I cover episodes related to debt default and restructuring. I have written extensively on these issues as well. My book, *American Default*, addresses President Roosevelt’s response to the Great Depression as one of the most important debt restructurings by an advanced economy. Among other topics, my scholarship has included the analysis of issues related to sovereign debt sustainability and the probability of debt restructuring.

4. I have significant expertise and experience in developing economic projections. Most of my teaching focuses on macroeconomics, including topics specifically related to aggregate income and growth, and some of my most highly cited academic work is related to models and analyses of economic growth. Additionally, one of my key responsibilities at the World Bank was to oversee the projection of growth paths for a large group of Latin American countries. To develop these projections, our team also needed to forecast growth in the major advanced economies, because their performance affects emerging markets’ exports. I have also performed economic evaluations of projects related to electric power in Costa Rica and Chile.

5. My research interests include emerging markets, currency crises, capital markets, Latin America, social conditions, income distribution, poverty, monetary policy, and the Federal Reserve. I have authored numerous academic articles on international distressed debt, rate adjustment, and recovery, which have appeared in leading academic journals, including *American Economic Review*, *Quarterly Journal of Economics*, *Review of Economics and Statistics*, *Journal of International Economics*, and *Journal of Development Economics*, among many others.

6. I have served as an expert witness in several cases involving exchange rates, international securities, international taxation, credit events, international investment disputes, and other economic and financial issues related to developing and emerging countries. A copy of my CV, together with a list of the trial and deposition testimony I have given in the past four years, is attached as **Appendix A**.

7. I am compensated at the rate of \$1,000 per hour for my time. In carrying out my assignment, I have directed and supervised employees of Analysis Group, Inc., an economic consulting firm, though the views and conclusions in this report are mine. Neither my compensation nor that of Analysis Group is contingent upon my findings, the testimony I may give, or the outcome of this litigation.

8. In performing the research and analysis for my report, I considered the documents and data listed in **Appendix B** and/or cited in this report and exhibits.

9. My opinions and the basis for my opinions are contained in the remainder of this narrative. I may revise, supplement, or expand my opinions, if necessary, based on review and analysis of information provided to me subsequent to the submission of this report.

## **II. SUMMARY OF OPINIONS**

10. An important input into the Board's projection of the amount of PREPA's future revenues that are available to fund creditor recoveries under the Plan of Adjustment is its projection of electricity load from now until FY2051. And a key input into its electricity-load projection is, in turn, a projection of the growth in Puerto Rico's real Gross National Product ("GNP") in each year from now until FY2051. It follows that, for the Board's load projection



(and therefore its available-net-revenue projection) to be reliable, its projection of GNP growth likewise must be reliable.

11. The Board's GNP projection, however, is not at all reliable, for a host of reasons. First and foremost, the model that the Board uses to predict growth in GNP predicts an economic decline that it expects to persist for nearly the next *three decades*. Extending Puerto Rico's GNP trajectory from its initial downturn in FY2006 in this manner would generate an economic decline unprecedented in modern history. Such a sustained economic decline is all the more improbable in light of Puerto Rico's recently observed economic recovery. The sheer implausibility of the Board's predicted result undermines confidence in its model.

12. The Board's dire prediction of Puerto Rico's economic failure is a product of its linear regression model, which is unsuited to the task of projecting long-term economic growth. Based upon historical data, the Board's linear regression attempts to estimate statistical relationships between certain observed macroeconomic factors and past GNP growth. It then uses those estimated relationships to predict future GNP. Thus, a premise of the regression exercise is that, to the extent there was a mathematical correlation in the past between, for example, changes in oil prices and GNP growth, that same mathematical correlation can be expected to continue long into the future.

13. Prevailing academic scholarship warns against the use of a linear regression to estimate future economic growth, however, and particularly over long time horizons such as the one considered by the Board. That is because, among other things, there generally is no basis to assume that the observed statistical relationship among variables will persist beyond the historical period under observation. In this case, the Board's linear regression-based forecast is especially subject to error, because Puerto Rico is undergoing a significant rebuilding of its

infrastructure, and has begun enacting transformational economic policy changes, with the specific objective of making the future economic trajectory different from the historical one.

14. The linear regression at issue here is further flawed because it omits any consideration of the impact of labor—which is a key driver of economic growth—on future GNP figures. It also relies upon unreasonably pessimistic assumptions about the future path of one of the key inputs that it does consider—capital stock. Contrary to the economic evidence, it assumes a long-term *decline* in capital stock in Puerto Rico that, were it actually to occur, would be an extreme outlier and similar only to the experience of countries suffering from economic collapse. The Board’s GNP projection also assumes, contrary to available evidence, that expected infrastructure reform will have zero effect on future economic growth. Finally, the Board’s projection of GNP that is used to project load, excludes without explanation the impact of COVID-19, including relief payments, despite that its own model estimates those payments to have a positive effect and to generate economic growth.

15. In sum, through a combination of flawed economic modeling and unreasonably pessimistic assumptions about the impact of reconstruction and reforms, the Board generates a prediction that Puerto Rico’s economy will languish in economic decline and never recover. If that happens, it will be unique in modern economic history. In my opinion, that is not a realistic outcome.

16. The accepted methodology for projecting long-term economic growth is to estimate what is known as “Potential Output” by relying upon the Solow Growth Model. The Solow Growth Model identifies three primary drivers of growth: capital, labor and “total factor productivity” (which represents advances in production and efficiency in an economy), and models them to interact in meaningful ways that reflect basic economic principles. Unlike the

Board's regression model, the Solow Growth Model develops economic growth projections from the bottom up, by evaluating the key inputs that drive economic growth.

17. I have estimated Puerto Rico's long-term economic growth using the Solow Growth Model and relying upon standard methods from the economic literature and updated data. I replaced the Board's most pessimistic and unreasonable assumptions with realistic but conservative assumptions, even where more optimistic modeling choices are supported by economic evidence. Aside from that, for ease of comparison, I have adopted the Board's assumptions, including its modeling of the impact of various fiscal spending policies, without any changes. As my projection shows, based on appropriate modeling and more realistic assumptions, Puerto Rico's GNP is likely to continue on its current path of recovery and economic growth and finish the projection period, in FY2051, significantly higher than as predicted by the Board's model.

18. Separately, I consider whether a reduction (or "haircut") on bondholders' recovery of the size contemplated in the Plan of Adjustment may impair PREPA's future access to credit markets on reasonable terms. Academic studies have shown that, in the sovereign debt context, haircuts on sovereign debt that are "inexcusable" result in reputational damage to the sovereign. A haircut is inexcusable if the amount is not justified by macroeconomic circumstances. If PREPA is capable of substantial or even full repayment of the PREPA bonds, then the haircut proposed by the Plan of Adjustment would be inexcusable. In that event, the "market punishment" dynamic observed in the sovereign debt context may occur here as well. The result could be that PREPA would face a higher cost of capital once it emerges from bankruptcy, and may even be excluded for a time from the capital markets.

19. The Commonwealth has a history of interfering with PREPA servicing its debt, including (i) refusal to pay its overdue balances to PREPA; (ii) refusing to allow PREPA to increase rates to cover costs; (iii) involvement in management and personnel appointments; and (iv) sanctioning subsidies that reduce PREPA's revenues. These interferences have limited the revenues that PREPA has available to repay its debts. I conclude that market perceptions of the Commonwealth's political interference in PREPA's management and policies could also result in higher future borrowing costs. That is because lenders would demand a higher rate of return to compensate them for the higher risk associated with their loans.

### III. BACKGROUND

20. On December 16, 2022, the FOMB proposed a Title III Plan of Adjustment of PREPA, which was amended most recently (as of this report) on March 1, 2023 (the "Plan of Adjustment").<sup>3</sup> The Plan of Adjustment, and its background, are described in a Disclosure Statement amended most recently on March 1, 2023 (the "Disclosure Statement").<sup>4</sup>

21. The Plan of Adjustment proposes issuance of two new series of bonds to restructure PREPA's debt.<sup>5</sup> Payment for these bonds will come from revenues generated through a combination of volumetric and connection charges that differ based on customer classes

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<sup>3</sup> "Puerto Rico's Debt Restructuring Process," *Financial Oversight and Management Board for Puerto Rico*. Accessed April 18, 2023, <<https://oversightboard.pr.gov/debt/>>.

<sup>4</sup> See Disclosure Statement for Modified Second Amended Title III Plan of Adjustment of the Puerto Rico Electric Power Authority, dated March 1, 2023, and accompanying exhibits (henceforth, "Disclosure Statement").

<sup>5</sup> The new bonds include Series A and Series B bonds. The Series A bonds are for Fuel Line Lenders and would be issued in a principal amount corresponding to 84 percent of their claims. Fuel Line Lenders refers to lenders that provided financing to PREPA for the purchase of fuel (Disclosure Statement, p. 8 and p. 2, fn. 7). The Series B bonds are further divided in Series B-1 and B-2 Bonds. Series B-1 Bonds are current interest bonds with a six percent semi-annual interest rate and have the principal amount of \$4.63 billion. Series B-2 Bonds are convertible capital appreciation bonds with a 6.75 percent annual interest rate and an original principal value of approximately \$400 million (Disclosure Statement, at pp. 35-37).

(“Legacy Charge”). The Plan of Adjustment postulates that, under various legal and economic scenarios, the highest recovery available to creditors from the debt restructuring is approximately 66 percent.<sup>6</sup>

22. I understand that load projections for residential, commercial, industrial, and other customers are inputs into calculating the amount of PREPA’s future revenues available for debt service. I understand further that these load projections use as inputs certain macroeconomic variables, including real GNP.<sup>7</sup> The GNP projection that serves as an input into residential and industrial load projections is generated by what the Board calls the Economic Outlook Model (“EOM”), which is described in the 2022 Commonwealth Fiscal Plan.<sup>8</sup>

#### **IV. THE GNP PROJECTION UNDERLYING THE PLAN OF ADJUSTMENT IS FUNDAMENTALLY FLAWED AND BIASED DOWNWARD**

23. In this section, I review the methodology, assumptions, and inputs underlying the EOM, and explain my conclusion that the EOM is an inappropriate framework for long-term GNP projections. The EOM also omits key factors relevant to GNP growth, and makes unjustifiably pessimistic assumptions about inputs that it does include. I show that these modeling choices generate a projection that the Puerto Rico economy will experience an economic contraction that will persist for *nearly three decades*. That projection is implausible,

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<sup>6</sup> Disclosure Statement, Exhibit K, at p. 10.

<sup>7</sup> Real GNP is an aggregate measure of economic output that is reported in dollars from a specific year—it is the product of the quantities of all goods produced in a given year and their prices from a previously determined “base year.” The need to fix prices arises from the fact that GNP is measured in dollars, so that changes in GNP from one year to the next result from a combination of changes in the quantities of goods that are produced and the prices of those goods. Thus, real GNP isolates the changes due to quantities by keeping the prices fixed over time. Nominal GNP is measured in current prices and does not isolate changes in quantities from changes in prices. (See, e.g., Mankiw, N.G., *Principles of Macroeconomics (6<sup>th</sup> Edition)*. (Mason: Thompson South-Western Cengage, 2012), at pp. 201-204.) Throughout this report, GNP refers to real GNP.

<sup>8</sup> 2022 Commonwealth Fiscal Plan, at p. 32 (“The baseline economic outlook model [...] forecasts real gross national product (GNP) growth”).

and it is not supportable by the available data or accepted principles of macroeconomic modeling. The projected, ever-downward trajectory for Puerto Rico's economy is contradicted by recent economic trends. Indeed, if Puerto Rico's economic future played out through FY2051<sup>9</sup> as the EOM predicts, then its economic performance starting in FY2006 would be worse than any economic decline, in any country with a sufficiently long history of data for comparison, observed in modern history.

24. The FOMB produced only a subset of the backup materials for the EOM and, as a result, my analysis is limited to the review of those materials that were available.<sup>10</sup> I reserve the right to update my analysis in response to any additional materials that are made available after this report is submitted.

#### **A. The Economic Outlook Model**

25. The EOM begins its forecast in FY2018. That is, FY2018 is the first year for which the Board projects a GNP figure, despite the fact that at the time of the 2022 Commonwealth Fiscal Plan's publication, data through FY2020 was available. The EOM replaces projected values for FY2018-FY2019 with actual data from the 2020 Statistical

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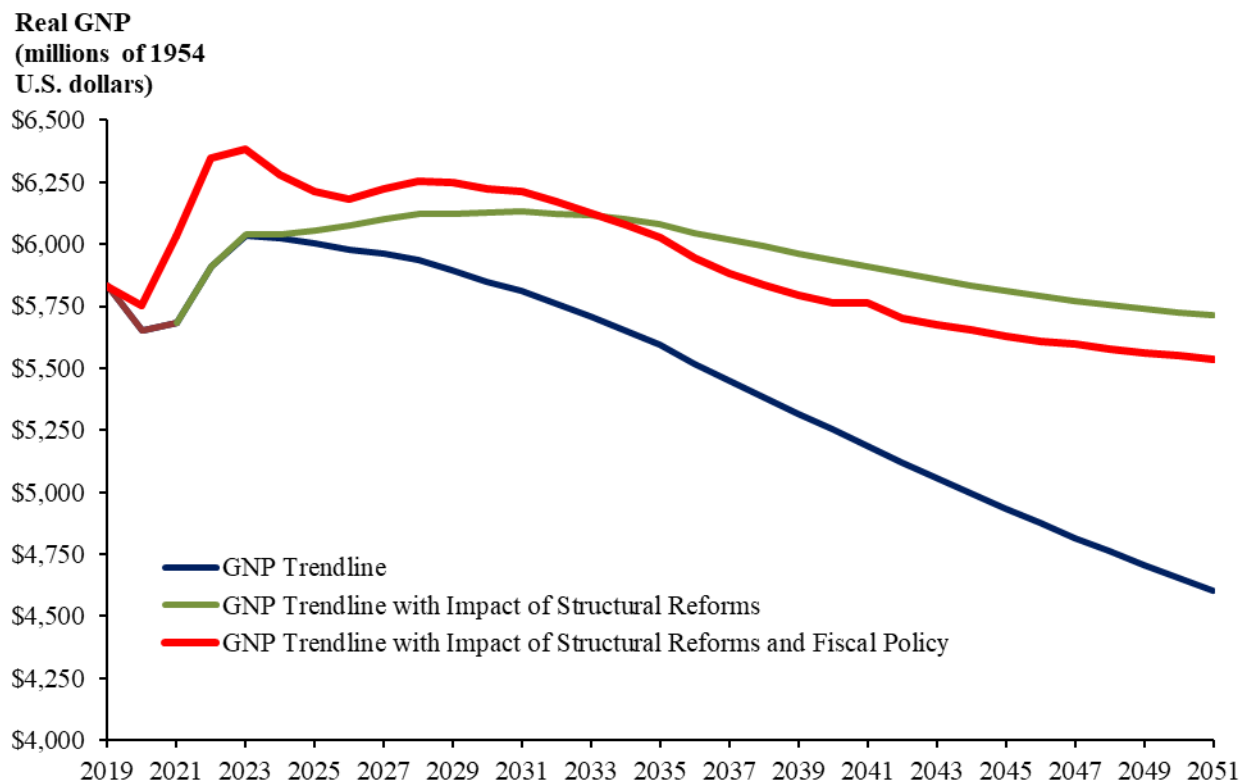
<sup>9</sup> FY refers to Fiscal Year, which is counted from July 1 to June 30, and is the unit of time for the EOM's projection.

<sup>10</sup> Examples of gaps in the backup materials include the codes and data to generate the coefficients in the linear regression discussed in Section IV.A.1.a and the backup for generating the assumptions of the model inputs discussed in Section IV.A.1.b. These materials are necessary for evaluating the reliability and robustness of the EOM's estimated model parameters. I understand the Board provided certain components of the regression backup one day before this report was filed and I have not yet reviewed those materials. In addition, backup materials for certain assumptions related to fiscal policy modeling were not available to me, such as the backup for certain parameters related to the Cyclical Reversal ("distribution of fiscal policy cyclical unwinding (years)" in Row 43 of Sheet "Macro Forecast" of the "January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx" workbook) and the COVID-19 income adjustment (in Rows 205-206 of Sheet "Macro Forecast" of the "January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx" workbook)) discussed in Section IV.A.3. Without more detailed information on these items, I am unable to evaluate the underlying assumptions for the EOM's modeling of fiscal policy.

Appendix when reporting its outputs, but it continues to rely on the projected values (not the actual data) for those fiscal years as inputs for purposes of generating its underlying trendline, which I describe below. Moreover, the EOM does not use actual data for FY2020 that was available at the time of the 2022 Commonwealth Fiscal Plan’s publication. Thus, the first year that a projected value is used is in FY2020, effectively.

26. The EOM generates a projection for Puerto Rico’s GNP for FY2020–FY2051 in three steps, which are illustrated in **Exhibit 1**.

**Exhibit 1: EOM Real GNP Projections FY2020–FY2051<sup>11</sup>**



<sup>11</sup> **Note:** Puerto Rico’s real GNP is reported in constant 1954 dollars. **Source:** 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”, Sheet “Macro Forecast”, Rows 15, 20-22, 25, 261, 264).

27. First, the EOM projects a trendline<sup>12</sup> based on estimates of the historical relationship between GNP growth and several other variables, together with assumptions about the future paths of those variables. As shown by the blue line in **Exhibit 1**, the projected trendline predicts a steady long-term decline. Second, the EOM revises that trendline by adding an estimated impact of various planned structural reforms that aim to generate economic growth (see the green line in **Exhibit 1**).<sup>13</sup> Third, the EOM purports to layer onto that revised trendline the further effect of various fiscal policies, including disaster relief funding, tax credits, spending reductions, and government efficiency measures. According to the EOM, these fiscal policies will be stimulative in the short-run and briefly generate growth, but over time will become contractionary and contribute to a long-term decline during most of the three-decade projection period. The red line in **Exhibit 1** incorporates fiscal policies and is the final resulting GNP projection in the EOM.

28. In the sections below, I discuss each of these three steps in more detail. I then explain how certain pessimistic assumptions regarding future investment and capital stock depreciation contribute to generating an improbable decline in future GNP. This decline is amplified by significant omissions from the EOM, including the assumption that infrastructure reform will provide no benefit to the economy.

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<sup>12</sup> The EOM projects GNP growth rates and then applies them to FY2019 GNP to generate GNP levels. The trendline is also projected in growth rates and can be similarly translated into levels.

<sup>13</sup> 2022 Commonwealth Fiscal Plan, at p. 26 (“The Oversight Board has stressed for the past five years that returning to economic growth requires structural reforms to enhance the reliability of power; improve educational outcomes, labor market participation and labor productivity; enhance the ease of doing business on the Island; and generate more effective returns on capital investments and infrastructure. All of this aims to strengthen Puerto Rico’s competitiveness in the global marketplace, attract new private capital, create jobs, and ultimately improve life for residents of the Island.”).



*1. Construction of the GNP Trendline*

29. The EOM begins by extrapolating GNP growth more than 30 years into the future based on a statistical technique called a “linear regression.” A linear regression assumes that the historical relationship during a particular period of time between one variable (the “dependent variable”) and a set of other variables (the “independent variables”) is linear and, given that assumption, estimates how changes in the values of the independent variables relate to, or “correlate” with, changes in the dependent variable during that time period.<sup>14</sup> The premise of the exercise is that the linear relationship between the independent variables and the dependent variable will carry on into the future.

30. The EOM’s linear regression uses historical data from FY1965 to FY2017 to establish statistical relationships between the independent variables and the dependent variable of the regression model.<sup>15</sup> In this case, the dependent variable is historical GNP growth and the independent variables are summarized in **Exhibit 2**.

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<sup>14</sup> See, e.g., Stock, J.H., and M.W. Watson., “Linear Regression with One Regressor,” *Introduction to Econometrics (Third Edition)*. (Pearson: New York, 2015). A linear relationship means that the change in the dependent variable from a one-unit change in the independent variable is the same, regardless of the size of the independent variable. Non-linear models, in contrast, allow for the change in the dependent variable from a one-unit change in the independent variable to differ with the size of the independent variable. For example, if it is assumed that height (dependent variable) and age (independent variable) form a linear relationship, then increasing age by one year will have a constant impact on height, regardless of age. A nonlinear relationship may find that the increase in height is large for early years and zero after adulthood.

<sup>15</sup> Certain backup materials for the EOM’s regression results were produced by the FOMB only one day before this report was filed, but given the late production, I have not yet reviewed the materials. The 2022 Commonwealth Fiscal Plan, however, suggests that the regression results are based on this time period. (2022 Commonwealth Fiscal Plan, at p. 32: “The baseline economic outlook model, which forecasts real gross national product (GNP) growth, primarily relies on a comprehensive dataset of the Puerto Rican economy from 1965 to 2017.”). Although data through FY2020 was available at the time the 2022 Commonwealth Fiscal Plan was published, it is not used in the model estimation (the 2020 Statistical Appendix, dated March 30, 2021, contained preliminary estimates of FY2020 real GNP (Table 3)).

## Exhibit 2: Independent Variables and Estimated Coefficients in the EOM Regression<sup>16</sup>

Independent Variable	Coefficient
<b>Past Values of GNP Growth</b>	
Previous Year's GNP Growth	0.42%
Structural Break in 2006 × Previous Year's GNP Growth	-0.28%
<b>U.S. Economy</b>	
U.S. GDP Growth	0.60%
Previous Year's U.S. GDP Growth	0.39%
<b>Capital Stock</b>	
Capital Growth	0.43%
Previous Year's Capital Growth	-0.21%
<b>Additional Control Variables</b>	
Change in World Oil Prices	-0.0086%
Change in Net Federal Transfer Payments	0.011%
Storm Intensity	-0.0015%
Constant	-0.023%

31. **Exhibit 2** also provides the coefficients for each of the independent variables that result from the linear regression model estimation.<sup>17</sup> These coefficients represent the magnitude of the change in the dependent variable (GNP growth) in response to a one-unit change in a given independent variable. For example, a one percent increase in U.S. real GDP growth is estimated to correspond to a 0.6 percent increase in Puerto Rico's real GNP.

<sup>16</sup> **Notes:** [1] Storm Intensity is defined as the damage caused by storms as a percentage of GNP. [2] Statistical significance of estimated coefficients is unknown because standard errors are not available. [3] Percent sign is included for exposition in the table. **Source:** 2022 Certified Commonwealth Fiscal Plan Excel Workbook ("January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx", Sheet "Macro Forecast", Rows 149-158, Column D).

<sup>17</sup> Economists typically consider whether a variable's coefficient is statistically significantly different from zero when evaluating its relevance and importance in a regression (*see, e.g.*, Stock, J.H., and M.W. Watson, "Review of Statistics" *Introduction to Econometrics (Third Edition)*. (Pearson: New York, 2015)). Because the 2022 Commonwealth Fiscal Plan Workbook contains only the coefficients and not the standard errors for those coefficients, I am unable to perform these tests and verify whether they are statistically significantly different from zero. (*See* 2022 Certified Commonwealth Fiscal Plan Excel Workbook ("January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx", Sheet "Macro Forecast," Cells D149-D158.)

32. As shown in **Exhibit 2**, the EOM's regression contains four broad categories of independent variables. First, Puerto Rico's GNP growth in the previous year is modeled to have an impact on its GNP growth in the current year. The previous year's GNP growth has a positive coefficient, which implies that if GNP contracted by one percent in the previous year, then GNP growth in the current year will be 0.42 percent lower. That is a statistical observation that the GNP growth variable is somewhat "persistent," meaning that changes in GNP in one year are correlated with GNP changes in the same direction in the next year.

33. Still in the same category, the other independent variable is also the previous year's GNP growth, but this time interacted with a "structural break" variable that purportedly captures a change in the persistence of GNP growth after 2006.<sup>18</sup> The Board does not explain why it assumes such a structural break, starting in 2006, in the relationship between GNP growth and previous year's GNP growth, and data is not available to me to evaluate whether there is statistical evidence within the EOM's linear regression to support that assumption.<sup>19</sup> In any case, the coefficient calculated for this independent variable reflects that, starting in 2006, a one percent decline in GNP results in a 0.14 percent decline (rather than an 0.42 percent decline) in GNP in the following year.<sup>20</sup>

34. The second category of independent variables shown in **Exhibit 2** is meant to account for the impact of the U.S. economy on Puerto Rico's GNP. The regression includes both

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<sup>18</sup> See 2022 Certified Commonwealth Fiscal Plan Excel Workbook ("January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx"), Sheet "Macro Forecast," Cell AQ176 ("No structural changes after 2006").

<sup>19</sup> I understand the Board provided certain components of the regression backup one day before this report was filed and I have not yet reviewed those materials.

<sup>20</sup> The structural break term is equal to zero in all years before and including 2006 and then becomes one for all remaining years. Therefore, the coefficient on GNP growth is  $0.42 - 0.28 \times \text{"structural break."}$  Because the structural break term equals zero before and including 2006, the coefficient on prior-year real GNP growth is 0.42 (i.e.,  $0.42 - 0.28 \times 0 = 0.14$ ) in those years, and after 2006, the structural break term becomes one so that the coefficient becomes 0.14 (i.e.,  $0.42 - 0.28 \times 1 = 0.14$ ).

current year U.S. GDP growth and the previous year's value, and models that a one percent increase in U.S. GDP increases Puerto Rico's GNP by 0.6 percent that same year and another 0.39 percent the following year.

35. The third category of independent variables shown in **Exhibit 2** includes growth in Puerto Rico's capital stock in the current and previous years. Capital stock refers to "the stock of equipment and structures that are used to produce goods and services" in an economy.<sup>21</sup> The coefficients associated with capital stock growth imply that a one percent increase in the capital stock increases GNP by 0.43 percent within the same year and *reduces* GNP by 0.21 percent the following year.

36. Finally, the fourth category of variables shown in **Exhibit 2** is a group of additional factors that the model finds to have a correlation with Puerto Rico's GNP growth in the same year. The change in world oil prices has a negative coefficient, so that a one percent increase in world oil prices brings Puerto Rico's GNP growth down by 0.01 percent in that year. The change in net federal transfer payments refers to the increase or decrease in the difference between transfers received and payments made to the federal government (for various programs such as, *e.g.*, Unemployment Insurance, Medicare, and Social Security).<sup>22</sup> The growth of net federal transfer payments has a positive coefficient, so that a one percent growth in net federal transfer payments increases GNP by 0.01 percent. The storm intensity variable is constructed using estimates of damage, caused by hurricanes and the negative coefficient implies the higher

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<sup>21</sup> See, *e.g.*, Mankiw, N.G., *Principles of Macroeconomics (6<sup>th</sup> Edition)*. (Mason: Thompson South-Western Cengage, 2012), at p. 241.

<sup>22</sup> See, *e.g.*, Statistical Appendix of the Economic Report for the Governor and Legislative Assembly, 2020, at Table 21.

the damage the more severe the resulting contraction in GNP.<sup>23</sup> This category also includes a constant term, which represents a baseline of Puerto Rico's GNP growth: if there is no change in any of the other independent variables, Puerto Rico's GNP growth declines by 0.023 percent.

37. The EOM then uses the linear regression to predict a future GNP trendline. To project GNP growth starting in FY2018,<sup>24</sup> the EOM forecasts each of the independent variables listed in **Exhibit 2** and then multiplies them by the corresponding coefficients. That is, in each year in the projection from FY2018 to FY2051, GNP growth is calculated as the sum of each independent variable's forecast for that year multiplied by the corresponding coefficient (shown in **Exhibit 2**). The output of this exercise is a series of growth rates that generate the unmodified version of the EOM's projected future GNP trendline, as depicted by the blue line in **Exhibit 1**.<sup>25</sup> The unmodified trendline predicts that, starting in FY2023, Puerto Rico will have negative GNP growth, year-after-year, through FY2051, for a cumulative decline in real GNP of 24 percent—a remarkable contraction in Puerto Rico's economy in less than three decades.

## 2. *Structural Reforms*

38. The 2022 Commonwealth Fiscal Plan describes five sets of structural reforms:

(i) "Human capital and welfare reform" aims to incentivize participation in the labor force through tax incentives and offer programs that make the labor force more productive<sup>26</sup>; (ii) "K-

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<sup>23</sup> The storm intensity variable is calculated as the ratio of the damage from storms to nominal GNP. The coefficient is negative so that a storm that generates damage equal to one percent of nominal GNP decreases real GNP growth by 0.002 percent.

<sup>24</sup> The 2022 Commonwealth Fiscal Plan mentions a "pre-hurricane trendline of Puerto Rico" in the description of the EOM (at p. 32), suggesting that the FY2017 cutoff intentionally ignores post-hurricane data.

<sup>25</sup> Even though the linear regression projection starts in FY2018, to obtain the trendline, the growth rates projected by the linear regression are applied to real GNP starting in FY2019 because that is the last actual data point produced in the EOM.

<sup>26</sup> 2022 Commonwealth Fiscal Plan, at Chapter 7.

12 education reform” includes various curriculum reforms and targeted investments to improve outcomes in schools and raise the quality of public schools<sup>27</sup>; (iii) “Ease of doing business reforms” overhauls various government procedures such as permit applications and tax collection, among other initiatives, to make Puerto Rico more business-friendly and spur growth<sup>28</sup>; (iv) “Power sector reform” aims to improve energy provision through better regulation and investment in renewable power generation<sup>29</sup>; and (v) “Infrastructure reform” will restructure management of transit assets and improve investment in the transportation network so that commute times decrease and the movement of people, goods, and services becomes more efficient.<sup>30</sup>

39. The EOM revises the unmodified projected trendline, discussed in the previous section, to account for incremental GNP growth rates in future years from the anticipated economic effects of these planned structural reforms. **Exhibit 3** shows the incremental projected GNP growth beyond that unmodified trendline that is associated with these five reforms.

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<sup>27</sup> 2022 Commonwealth Fiscal Plan, at Chapter 8.

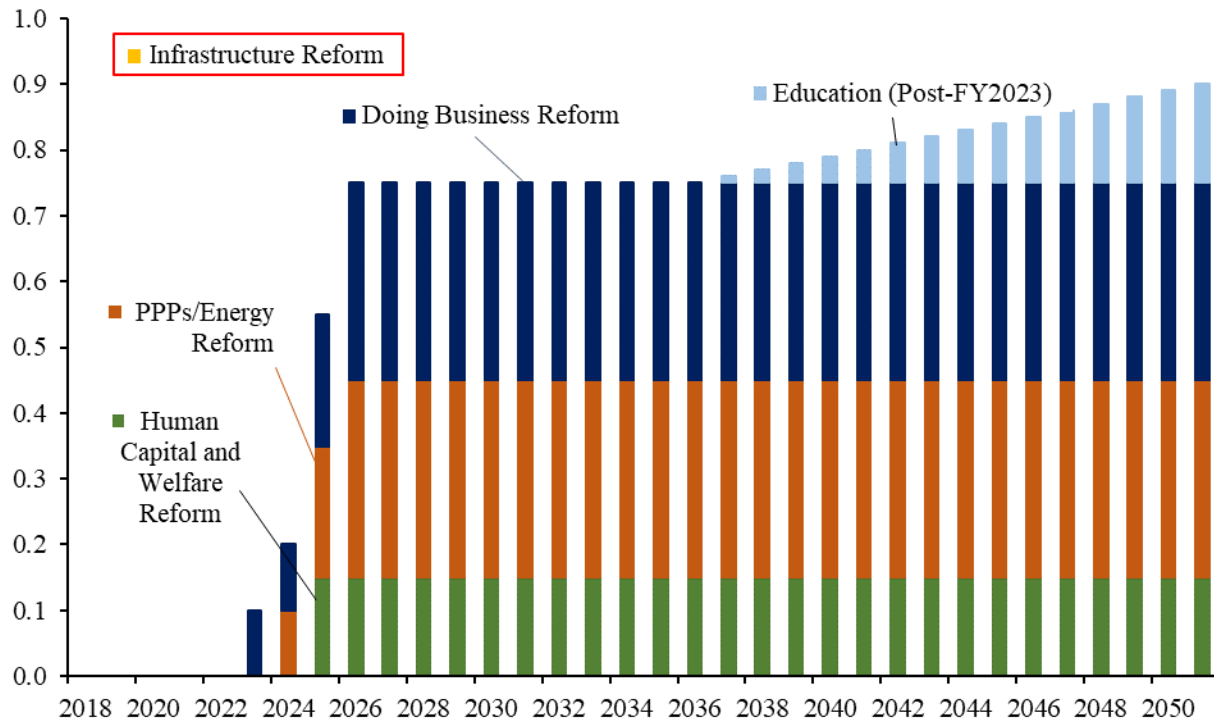
<sup>28</sup> 2022 Commonwealth Fiscal Plan, at Chapter 9.

<sup>29</sup> 2022 Commonwealth Fiscal Plan, at Chapter 10.

<sup>30</sup> 2022 Commonwealth Fiscal Plan, at Chapter 11.

### Exhibit 3: Cumulative Impact of Structural Policy Measures on Puerto Rico's GNP FY2018–FY2051<sup>31</sup>

#### Impact on GNP Growth Rate (%)



### 3. Fiscal Policy

40. The EOM also adjusts the GNP trendline to account for the anticipated impact of various proposed new fiscal policies. Each of these policies is modeled based on the dollar amount of government spending (or savings) that they represent. To reflect the effect of these

<sup>31</sup> **Notes:** [1] Human Capital and Welfare Reform refers to reforms “that will improve the well-being and self-sufficiency of all Puerto Rico residents, increase the quality and competitiveness of the workforce, enable investment, and facilitate the economic modernization of the Island.” [2] PPPs/Energy Reform refers to reforms “that will improve the availability, reliability, and affordability of energy for families and businesses.” [3] Doing Business Reform refers to reforms “that will improve conditions for economic activity and business vitality, attracting new investment and creating jobs.” [4] Infrastructure Reform refers to reforms “that will improve the flow of goods, services, information, and people across the Island.” Assumed to have no impact on GNP. [5] Education reform refers to reforms “that will position all students to succeed in school and upon graduation by raising the quality of the Island’s public schools.” **Sources:** [A] 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”, Sheet “Macro Forecast”, rows 132-136). [B] 2022 Commonwealth Fiscal Plan, at p. 77.

positive or negative dollar amounts on GNP, the EOM applies a “fiscal multiplier.” A fiscal multiplier represents a measure of the amount by which government spending is assumed to have a multiplicative effect on the economy.<sup>32</sup> In the EOM, the fiscal multiplier is set to 1.34, so that \$1 of fiscal spending increases GNP by \$1.34.<sup>33</sup>

41. With the exception of some portions of certain federal contributions (Earned Income Tax Credit, the Child Tax Credit, and the Supplemental Nutritional Assistance Program), which are modeled to have a permanent effect on GNP,<sup>34</sup> the other fiscal policies accounted for by the EOM are assumed to have only a temporary effect. For those fiscal policies, the EOM reverses the policy’s effect on GNP growth over the next five years, using a mechanism it refers to as a “Cyclical Reversal.”<sup>35</sup> For example, if a certain fiscal policy is modeled to boost the GNP growth rate by ten percent in year one, then a Cyclical Reversal would follow that up with approximately two percent declines in the GNP growth rate in each of the following five years.

42. In addition to the specific tax credits and assistance program mentioned above, the broad categories of fiscal policies considered by the EOM include spending associated with anticipated disaster relief funding (excluding some that flows into capital stock),<sup>36</sup> planned fiscal

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<sup>32</sup> For example, when the government makes a purchase from a firm, the workers at that firm may receive additional earnings that they themselves spend on consumer goods. The producers of those consumer goods then gain extra earnings that they spend, and so on. (See, e.g., Mankiw, N.G., *Principles of Macroeconomics (6<sup>th</sup> Edition)*. (Mason: Thompson South-Western Cengage, 2012), at p. 472).

<sup>33</sup> 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”), Sheet “Macro Forecast,” D144.

<sup>34</sup> 2022 Commonwealth Fiscal Plan, at pp. 30-31, and 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”), Sheet “Macro Forecast,” Cells M246, N246.

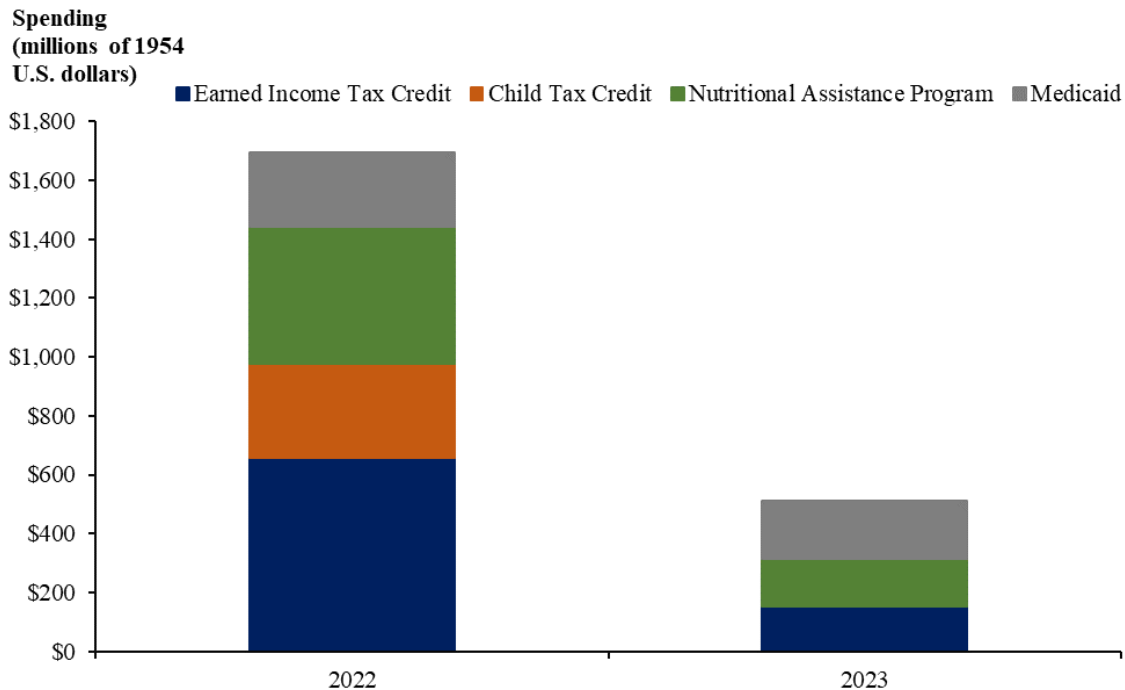
<sup>35</sup> 2022 Commonwealth Fiscal Plan, at p. 44 and 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”), Sheet “Macro Forecast,” Rows 43, 45.

<sup>36</sup> Amounts from Disaster Relief Funding that flow into capital stock do not constitute the funds’ initial balance. Rates of pass-through are applied to the different types of Disaster Relief Funding to account for amounts directed to consumption. As a result, a portion of the Disaster Relief Funding ends-up flowing into capital stock, e.g., 84.5% of funding used to construct and repair utilities, 76.5% of funding employed to construct and repair



measures aimed to make government more efficient,<sup>37</sup> and income support during the COVID-19 pandemic.<sup>38</sup>

#### Exhibit 4: Fiscal Policies with Permanent Effect on GNP FY2022–FY2023<sup>39</sup>



residential, commercial, school buildings, and programs and services. (See 2022 Commonwealth Fiscal Plan, at p. 38).

<sup>37</sup> Planned fiscal measures include the net effect of revenue measures and expense measures. Revenue measures represent the increase in tax revenues and expense measures include the cost savings. The EOM considers the combined net impact of revenue and expense measures. That is, an increase in expenses (meaning, additional government spending) is modeled to have a positive impact on GNP, whereas an increase in revenues (meaning, additional taxes collected) is modeled to have a negative impact on GNP. See 2022 Commonwealth Fiscal Plan, at p. 44.

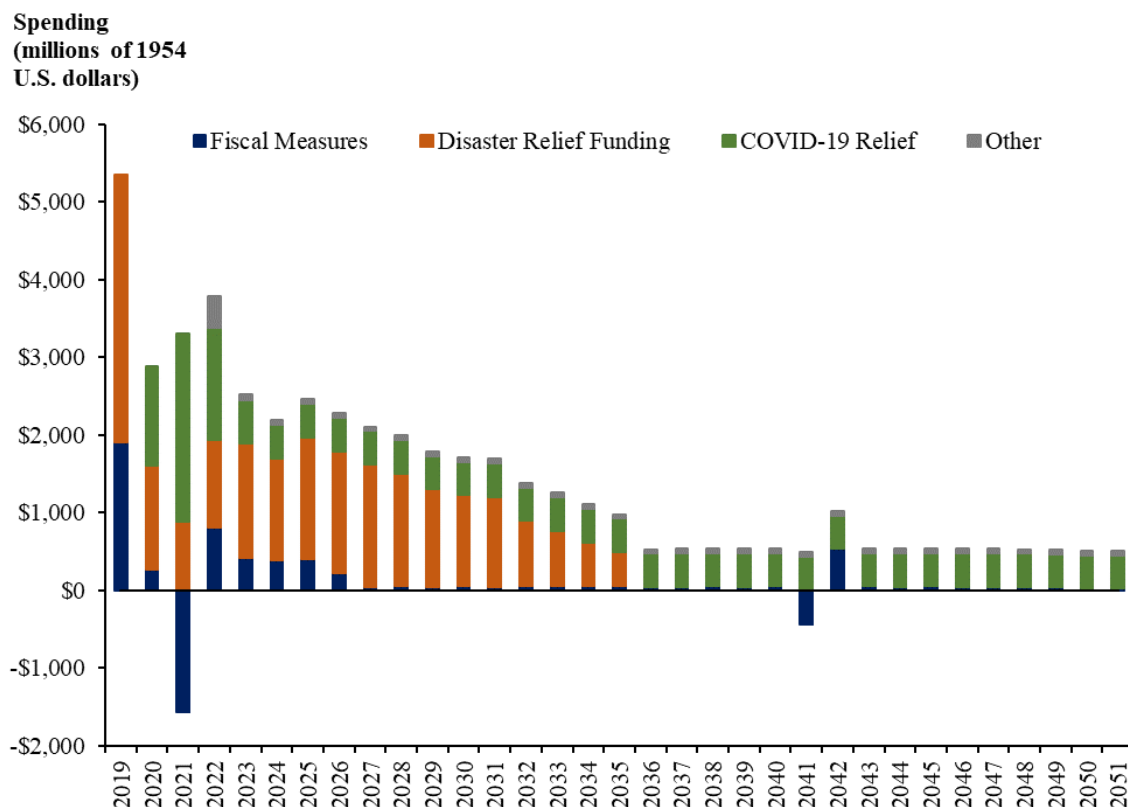
<sup>38</sup> The impact of COVID-19 is modeled to purportedly account for both lost income due to unemployment and federal government income support rolled out during the pandemic. See 2022 Commonwealth Fiscal Plan, at p. 35 (“The approach accounts for two primary factors, which are outlined below: (i) lost income from an enduring spike in unemployment, and (ii) the relative amount of income that will be replaced by extraordinary Federal Government support.”).

<sup>39</sup> **Notes:** [1] The above fiscal policy measures only have a permanent impact on growth (i.e., not subject to cyclical reversals) for years 2022 and 2023. [2] The above fiscal policy measures are subjected to the 2022 Commonwealth Fiscal Plan’s fiscal multiplier of 1.34.

**Source:** 2022 Certified Commonwealth Fiscal Plan Excel Workbook (January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”, Sheet “Macro Forecast”, Rows 15, 222, 231, 235, 244).

43. The dollar amounts corresponding to fiscal policies that have a permanent effect on GNP are shown in **Exhibit 4** for the two years in which they occur and those that have a temporary effect are shown in **Exhibit 5**. Some of the COVID-19 subsidy relief received over FY2020-2023 is modeled to be spent immediately and some of it is modeled to be saved and spent in later years.<sup>40</sup> The effect on GNP of those policies, together with the Cyclical Reversal is shown by the red line in **Exhibit 1**.

#### Exhibit 5: Fiscal Policies with Temporary Effect on GNP FY2019–FY2051<sup>41</sup>



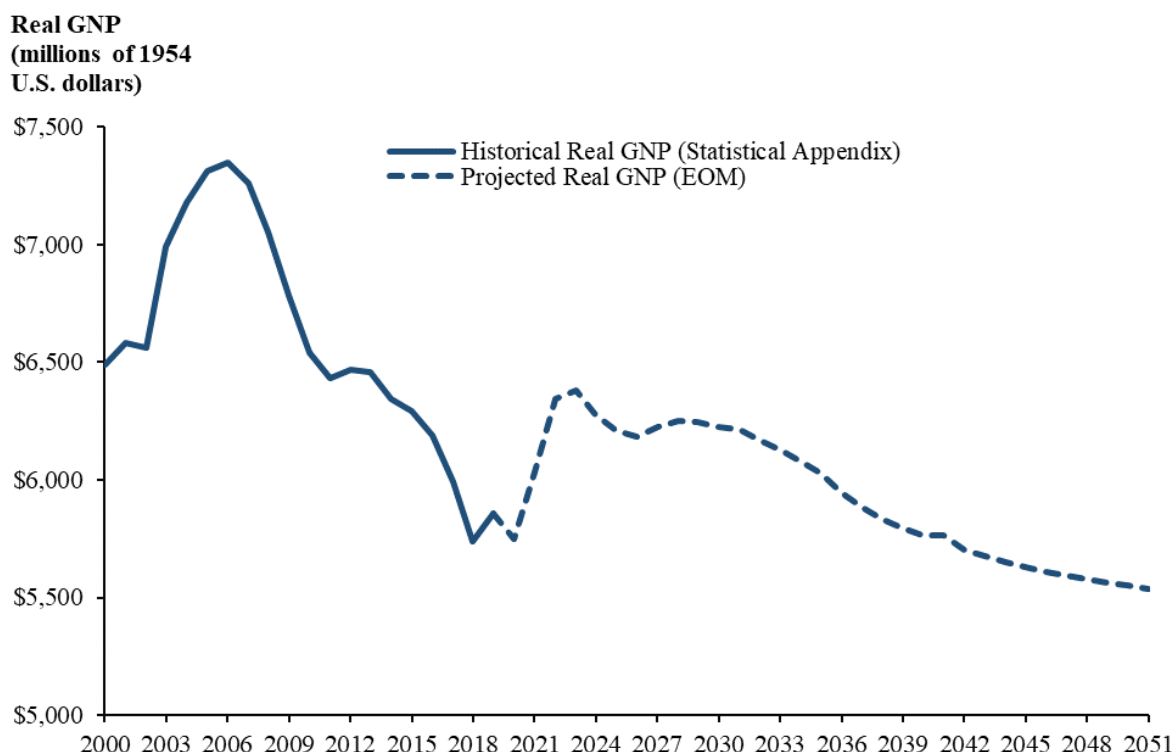
<sup>40</sup> 2022 Commonwealth Fiscal Plan, at p. 43 (“[T]he 2022 Fiscal Plan estimates that around 60% of income support funding will be spent over the FY2020-FY2023 period. The remaining 40% of funds is projected to be saved and/or used to pay down debt, and then is spent over a 30-year period according to the long-term consumption smoothing concept.”).

<sup>41</sup> **Notes:** [1] Fiscal Measures refers to the year-over-year change in the net impact of fiscal measures undertaken by the Puerto Rican government. [2] Other refers to annual spending on the CTC, or Child Tax Credit. [3] The above

## B. The EOM Predicts an Unprecedented Recession Worse than Anything Observed in Modern History

44. Before considering the multiple respects in which the Board’s EOM is unsuited to the task of projecting long-term economic growth, it is helpful to have in mind, as context, the actual path it predicts for Puerto Rico as shown in **Exhibit 6**.

**Exhibit 6: Historical and Projected Real GNP in Puerto Rico FY2000–FY2051<sup>42</sup>**



elements are subjected to the 2022 Commonwealth Fiscal Plan’s fiscal multiplier of 1.34. [4] Disaster Relief Funding is calculated as the sum of Net Impact of Relief Spending to Capital Stock and Net Impact of Relief Spending external of Capital Stock, minus COVID-19 Relief and CTC annual spending (both of which are already included in the latter).

**Source:** 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx,” Sheet “Macro Forecast,” Rows 120, 122, 124, 209, 230).

<sup>42</sup> **Sources:** [A] Statistical Appendix of the Economic Report for the Governor and Legislative Assembly, 2009-2021, Table 3. [B] 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx,” Sheet “Macro Forecast,” Row 25).

45. In particular, the EOM forecasts an economic decline that continues indefinitely and from which Puerto Rico never recovers (during the long forecast period, at least). To put this forecast into context, I studied worldwide historical recessions since 1960 and compared individual countries' subsequent experiences to the EOM's projections for Puerto Rico. My analysis shows that the EOM's predictions of a sustained decline in the Puerto Rico economy is inconsistent with the recovery experienced by every country and territory in the world following an economic downturn between 1960 and 2021.

46. According to Puerto Rico's Statistical Appendix, Puerto Rico's real GNP began declining in FY2006, and as of FY2021 had experienced a cumulative decline of 22 percent.<sup>43</sup> The World Bank maintains a database of historical economic indicators containing data for most countries worldwide back to 1960.<sup>44</sup> I reviewed the World Bank's database for all instances, since 1960, in which countries or territories experienced a cumulative decline in real GDP that was at least as large as Puerto Rico's cumulative decline in real GNP. According to the data, between 1960 and 2021, 68 out of 216 countries or territories experienced a cumulative drop in real GDP of 22 percent or more between any two years in a 30-year time span.

47. **Exhibit 7** presents real GDP trajectories for these 68 countries starting with the first year of decline. Each series carries through to the latest available year of data, and is indexed to the first year of the decline. **Exhibit 7** also shows Puerto Rico's historical real GNP from FY2006 to FY2019 followed by the EOM's forecasted real GNP from FY2020 through FY2051. As the exhibit shows, the overall trend forecasted by the EOM would result in a long

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<sup>43</sup> Statistical Appendix of the Economic Report for the Governor and Legislative Assembly, 1989-2021, Table 3.

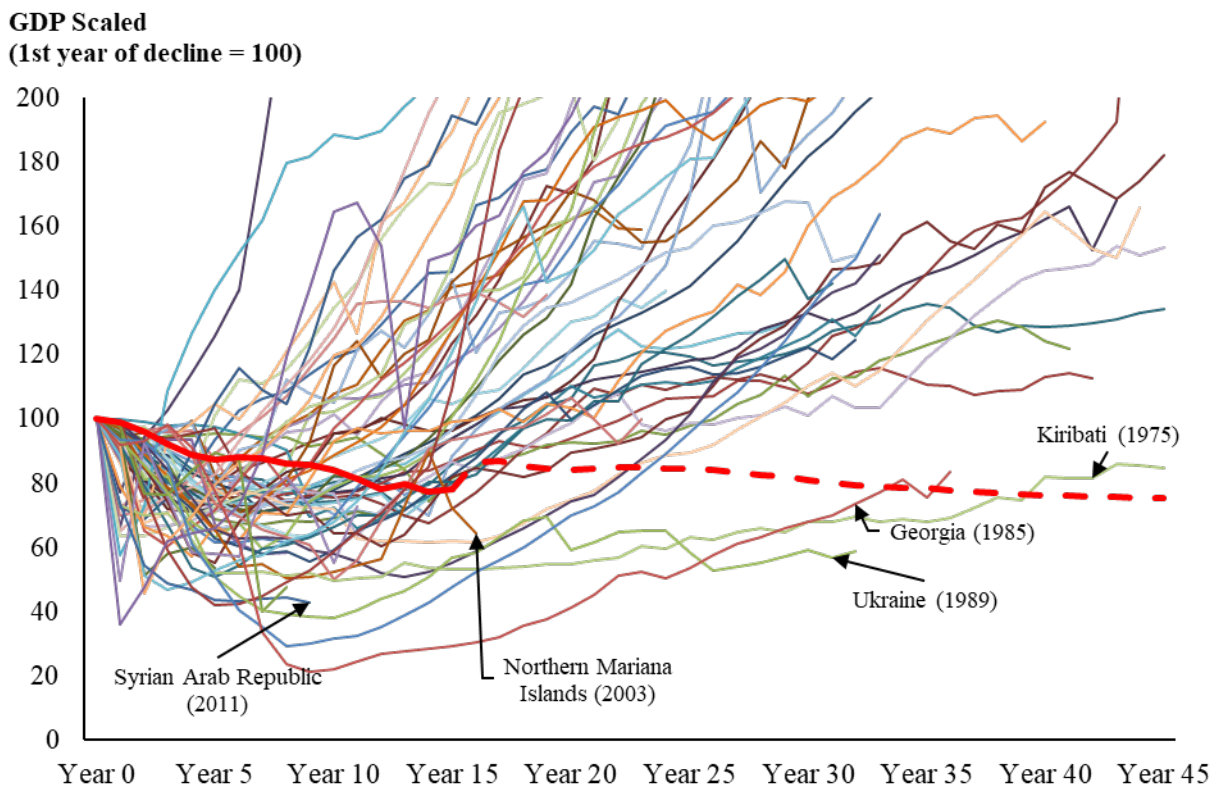
<sup>44</sup> "World Development Indicators," *The World Bank*, 2023. Accessed April 20, 2023, <<http://data.worldbank.org/data-catalog/world-development-indicators>>.

decline well below the observed historical trends of nearly all other countries.<sup>45</sup> The fact that the EOM's forecast for Puerto Rico's economic future is such a clear outlier, compared to the post-decline economic trajectories historically experienced by the rest of the world, suggests that it is unreasonably pessimistic.

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<sup>45</sup> The few countries that do not show relatively quick recoveries have substantially different circumstances than Puerto Rico. Syria's initial decline in GDP corresponds with the start of ongoing civil war (*see* "Why has the Syrian war lasted 11 years?," *BBC News*, March 15, 2022. Accessed April 20, 2023, <<https://www.bbc.com/news/world-middle-east-35806229>>). The Northern Mariana Islands have a much smaller population than Puerto Rico (less than 50 thousand inhabitants), and their economy is much less diverse, with about 50% of workers employed in tourism. (*see* "Northern Mariana Islands," *Gregorio Sablan*. Accessed April 20, 2023 <<https://sablan.house.gov/our-district>>). Ukraine experienced economic declines following the breakup of the USSR, and economic reforms were stalled due to "a large voting bloc that [was] strongly suspicious of further retreat of government from the economy," and by Ukrainian oligarchs that "enjoy government-sanctioned monopolies" (*See* Dean, J., "Ukraine: Europe's Forgotten Economy." *Challenge*, 43, 6, 2000: 93-108, pp. 102-103). Kiribati consists of 33 islands "scattered over a vast area of ocean" in the central Pacific (about 1,800 miles), and the population is much smaller than Puerto Rico (less than 125 thousand) (*See* "Kiribati," *Britannica*. Accessed April 19, 2023, <<https://www.britannica.com/place/Kiribati>>). Georgia's economic decline involved its transition from a Soviet republic and a civil war (*See* "Assessment of Development Results - Georgia," *United Nations Development Programme*. Accessed April 20, 2023, <<https://www.oecd.org/countries/georgia/47861316.pdf>>, p. 5).

### Exhibit 7: Countries with Historical Decline in Real GDP Comparable to Puerto Rico's Real GNP Decline Since FY2006<sup>46</sup>



<sup>46</sup> **Notes:** [1] The solid red line is Puerto Rico's Real GNP according to the Statistical Appendix, and the dashed red line is the forecasted GNP from the 2022 Commonwealth Fiscal Plan. All other lines show the GDP (constant 2015 U.S. Dollars) for countries according to the World Bank. [2] Puerto Rico experienced a 22.03 percent decline in its Real GNP between 2006 and 2021. Countries listed here have experienced a decline of over 22.03 percent between any two years in a 30-year time span between 1960 and 2021. "Year 0" represents the first year of decline. For example, for Puerto Rico, "Year 0" is 2006. [3] 45 out of the 68 countries shown here (excluding Puerto Rico) had a last reported value greater than their Year 0 value. Of the 23 countries with a lower last reported value, only 11 have 10 years of data after Year 0. [4] Labeled countries have their Year 0 listed in parentheses. [5] Puerto Rico values from the 2022 Commonwealth Fiscal Plan and Statistical Appendix correspond to fiscal years. Values for other countries from the World Bank correspond to calendar years.

**Sources:** [A] "World Development Indicators," The World Bank, 2023. Accessed April 20, 2023, <<http://data.worldbank.org/data-catalog/world-development-indicators>>. [B] Statistical Appendix of the Economic Report for the Governor and Legislative Assembly, 1989-2021. [C] 2022 Certified Commonwealth Fiscal Plan Excel Workbook ("January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx," Sheet "Macro Forecast," Row 25).

**C. The EOM's Modeling Framework is Unsited for Projecting Puerto Rico's GNP, and its Inputs are Unreliable**

48. There is a well-established methodology in the field of macroeconomics for analyzing and projecting long-term growth in an economy. It comprises a bottom-up approach that is based upon the productive capacity of an economy, taking into account its capital, labor and productivity. The EOM either ignores, or departs from, this accepted methodology, which leads to unreliable results. In this section, I demonstrate that the methodology represented by the EOM is not suited for projecting Puerto Rico's long-term GNP growth.

*1. The EOM's Regression-based Approach is Ill-Suited for Puerto Rico's Long-Term Forecast*

49. As discussed above, the EOM relies on a linear regression model to project a trendline over 33 years into the future. Generally speaking, it does that by (i) drawing statistical relationships between a set of independent variables, on the one hand, and actual historical GNP, on the other hand; (ii) predicting future values of the independent variables; and then (iii) assuming that observed historical correlation between the independent variables and GNP will persist, unchanged, for the next three decades.

50. But the academic literature consistently warns that using a linear regression-based model for the purposes of such forecasting is "dangerous" in general,<sup>47</sup> and is especially so for

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<sup>47</sup> Mansfield, E., *Statistics for Business and Economics (Third Edition)*. (W. W. Norton & Company, Inc.: New York, 1980), at pp. 474–475 ("[R]egressions are sometimes used to forecast values... This procedure, known as extrapolation, is dangerous because the available data provide no evidence that the true regression is linear beyond the range of the sample data."). Chatfield, C., *Time-Series Forecasting*. (Chapman & Hall/CRC: Boca Raton, 2000), at Section 1.3 ("[Time-series] forecasts can even go horribly wrong in the short-term when there is a sudden change or 'structural break' in the data."). Armstrong, J.S., "Extrapolation for Time-Series and Cross-Sectional Data," Armstrong, J.S. (ed.), *Principles of Forecasting: A Handbook for Researchers and Practitioners*. (Kluwer Academic Publishers: Norwell, 2001), at p. 17 ("The assumption underlying extrapolation is that things will continue as they have. When this assumption has no basis, large errors are likely.").

long-term forecasts, where the assumption of a constant linear relationship over many years “gets very shaky.”<sup>48</sup> Yet, as discussed in Section IV.A.1, this exercise of “extrapolation” is exactly the method the EOM uses to generate the trendline that is the basis for the GNP projection underlying the Plan of Adjustment.

51. Using the coefficients estimated by a regression model over a *historical* time period to forecast over a *future* time period relies on two implicit assumptions. First, it assumes that the coefficients at issue are “estimated precisely” and are “stable,” such that although they were “estimated on one set of data [they] can be reliably used to make forecasts using other data.”<sup>49</sup> If the selected coefficients are either incorrect or unstable, the forecast likewise will be unreliable. By modeling a structural break (*see* Section IV.A.2), the EOM’s linear regression assumes itself that its coefficients are not stable over time. Second, relying on a linear regression in this context assumes that “things will continue to move [in the future] as they have in the past.”<sup>50</sup> As I discuss below, were it *ever* appropriate to rely on a linear regression to project growth in GNP, there must, at a minimum, be a sound basis for these two assumptions. In this case, however, neither of these two assumptions is reasonable in the context of a long-term economic projection for Puerto Rico.

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<sup>48</sup> See, e.g., Ott, R. L., and Longnecker, M., *An Introduction to Statistical Methods and Data Analysis (Sixth Edition)*. (Brooks/Cole: Belmont, 2010), at p. 596 (“Extrapolation...is often tempting and always dangerous... It is based on the assumption of a linear relation, and that assumption gets very shaky for large extrapolations.”). See also Armstrong, J.S., “Extrapolation for Time-Series and Cross-Sectional Data,” Armstrong, J.S. (ed.), *Principles of Forecasting: A Handbook for Researchers and Practitioners*. (Kluwer Academic Publishers: Norwell, 2001), at p. 16 (“[Time-series regression] extrapolation is based on an assumption that things will continue to move as they have in the past. This assumption is more appropriate for short-term than for long-term forecasting.”).

<sup>49</sup> Stock, J.H., and M.W. Watson, “Review of Statistics” *Introduction to Econometrics (Third Edition)*. (Pearson: New York, 2015), at p. 332.

<sup>50</sup> Armstrong, J.S., “Extrapolation for Time-Series and Cross-Sectional Data,” Armstrong, J.S. (ed.), *Principles of Forecasting: A Handbook for Researchers and Practitioners*. (Kluwer Academic Publishers: Norwell, 2001), at p. 16 (“[Time-series regression] extrapolation is based on an assumption that things will continue to move as they have in the past. This assumption is more appropriate for short-term than for long-term forecasting.”).



52. First, I have not reviewed the backup data supporting EOM's linear regression model (that I understand was produced one day before this report was filed), and so I cannot comment on the precision of its coefficient estimates. However, as I explain in the following section, the chosen coefficients likely suffer from statistical bias because the EOM omits labor, an important factor of production, among its independent variables. Moreover, the reliability of the coefficients is further undermined by the fact that the historical data used to estimate them is itself unreliable.

53. The unreliability of the data arises from the outdated accounting practices used by Puerto Rico's Planning Board to measure Puerto Rico's GNP and other econometric indicators.<sup>51</sup> The U.S. Bureau of Economic Analysis ("BEA"), which calculates U.S. real GDP, has stated that Puerto Rico's GDP calculation uses outdated methods and does not conform to international standards.<sup>52</sup> Likewise, according to the U.S. Government Accountability Office ("GAO"), Puerto Rico's Planning Board "uses outdated methods to calculate GDP, *which results in unreliable data* [...]."<sup>53</sup>

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<sup>51</sup> The Planning Board publishes these economic series in a Statistical Appendix to an annual Economic Report to the Governor and the Legislative Assembly. (See "Statistical Appendix to the Economic Report to the Governor," Puerto Rico Planning Board. Accessed April 25, 2023, <<https://jp.pr.gov/apendice-estadistico-del-informe-economico-a-la-gobernador>>).

<sup>52</sup> "Evaluation and Improvement of Puerto Rico's National Economic Accounts," *Bureau of Economic Analysis*, September 2011. Accessed April 19, 2023, <<https://jp.pr.gov/wp-content/uploads/2021/09/Evaluation-and-Improvement-of-Puerto-Ricos-National-Economic-Accounts-September-2011.pdf>>, at pp. 2–5.

<sup>53</sup> "Report by the President's Task Force on Puerto Rico's Status – Executive Summary," March 2011, emphasis added. Accessed April 19, 2023, <[https://obamawhitehouse.archives.gov/sites/default/files/uploads/Puerto\\_Rico\\_Task\\_Force\\_ExecSummary.pdf](https://obamawhitehouse.archives.gov/sites/default/files/uploads/Puerto_Rico_Task_Force_ExecSummary.pdf)>, at pp. 90–91; "Evaluation and Improvement of Puerto Rico's National Economic Accounts," *Bureau of Economic Analysis*, September 2011. Accessed April 19, 2023, <<https://jp.pr.gov/wp-content/uploads/2021/09/Evaluation-and-Improvement-of-Puerto-Ricos-National-Economic-Accounts-September-2011.pdf>>, at pp. 4–5. "Puerto Rico - Limited Federal Data Hinder Analysis of Economic Condition and DOL's 2016 Overtime Rule," *United States Government Accountability Office*, June 2018. Accessed April 19, 2023, <<https://www.gao.gov/assets/gao-18-483.pdf>>, at p. 1.

54. Further, a report from a bipartisan U.S. Congress task force explicitly identified potential flaws with Puerto Rico’s historical GNP data, noting that it “supports BEA’s efforts to help the government of Puerto Rico modernize its economic statistics programs, including the methods used to measure the island’s GDP (and GNP).”<sup>54</sup> As shown in **Exhibit 2**, the previous year’s GNP growth is one of the independent variables used in the EOM’s regression, so any errors in the data generated by these oft-criticized, outdated practices have a direct effect on the reliability of the model’s coefficients and resulting projections.<sup>55</sup>

55. Second, a bare minimum requirement for a regression to produce an accurate projection is a solid basis for assuming that the future will be similar to the past. But that assumption is not supportable here. Puerto Rico is undertaking significant structural reforms that are specifically intended to improve the island’s economic trajectory. The 2022 Commonwealth Fiscal Plan notes that these “transformational structural reforms” are intended to “*change the nature of Puerto Rico’s economic development trajectory* and provide the residents of the Island with a better and more prosperous future,” such that making these reforms will “transform the Island’s trajectory.”<sup>56</sup>

56. Therefore, it is unreasonable to assume that Puerto Rico’s economic future will behave like its past and doing so renders the EOM’s projections unreliable. In fact, the EOM’s

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<sup>54</sup> Specifically, the BEA notes that GDP is valuable to modernize and track because it is not susceptible to the issue of production outside of the island and is therefore generally more appropriate for short-term analysis of the Puerto Rican economy. “Congressional Task Force on Economic Growth in Puerto Rico – Report to the House and Senate,” *United States Congress*, December 20, 2016, emphasis added. Accessed April 19, 2023, <<https://www.finance.senate.gov/imo/media/doc/Bipartisan%20Congressional%20Task%20Force%20on%20Economic%20Growth%20in%20Puerto%20Rico%20Releases%20Final%20Report.pdf?platform=hootsuite>> (emphasis added.)

<sup>55</sup> For example, even a 0.1 percent estimation error that changes a 2.1 percent growth rate to 2.0 percent would imply a 5.7 percent difference in cumulative growth over a 31-year projection period.

<sup>56</sup> 2022 Commonwealth Fiscal Plan, at p. 342 (emphasis added).

failure to acknowledge the changes that structural reforms and disaster relief funding (“DRF”) will bring to the behavior of Puerto Rico’s economy is an example of a modeling error discussed in Robert Lucas, Jr.’s seminal paper on constructing macroeconomic models, for which he received the Nobel Prize in Economics in 1995. The “Lucas Critique” argues that regression models like this are flawed because the nature of an economy changes in response to economic policies.<sup>57</sup>

57. True, the EOM adjusts its trendline to take account of the estimated impact of these structural reforms, as I described in Section IV.A.2. But those adjustments do not resolve the problem with more generally assuming linear stability over three decades of anticipated economic reform. Importantly, the trendline adjustments have no impact on the underlying predictions of a stable, statistical relationships among independent variables and GNP growth that are reflected by the coefficients shown in **Exhibit 2**.

## 2. *The EOM Entirely Omits a Key Driver of Economic Growth: Labor*

58. GNP, which measures aggregate economic output—the total value of all goods and services produced in an economy—is determined by (i) the quantity of economic inputs and (ii) the economy’s ability to transform those inputs into outputs.<sup>58</sup> The ability to transform inputs into outputs depends on the available production technology, which economists refer to as the “production function.”<sup>59</sup> The inputs that enter the production function are called “factors of production” and “the two *most important* factors of production are capital *and* labor.”<sup>60</sup> As

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<sup>57</sup> Lucas, R.E., “Econometric Policy Evaluation: A Critique,” *Carnegie-Rochester Conference Series on Public Policy*, 1, 1976:19-46.

<sup>58</sup> See, e.g., Mankiw, N.G., *Macroeconomics (7<sup>th</sup> Edition)*. (Worth Publishers: New York, 2010), at p. 47.

<sup>59</sup> See, e.g., Mankiw, N.G., *Macroeconomics (7<sup>th</sup> Edition)*. (Worth Publishers: New York, 2010), at p. 48.

<sup>60</sup> See, e.g., Mankiw, N.G., *Macroeconomics (7<sup>th</sup> Edition)*. (Worth Publishers: New York, 2010), at p. 47.

shown in **Exhibit 2**, the EOM's linear regression does not include labor as an independent variable in its regression model, and, therefore, it necessarily ignores labor in its projection of the GNP trendline.

59. Not accounting for one of the key drivers of economic growth renders the EOM's forecast unreliable. In addition, excluding this relevant factor of production can lead to a serious statistical problem. If omitted variables (such as labor) are correlated with the independent variables that *are* included in a regression model, then the coefficients estimated in the regression model will suffer from "omitted variable bias." That means that the size of the estimated effects of the included variables on GNP are likely to be different than their true effects.<sup>61</sup> If the coefficients are biased, then the projection based on those coefficients would not even reflect the true relationship based on historical data.<sup>62</sup>

60. For all of these reasons, I conclude that the EOM's use of a linear regression to estimate Puerto Rico's future growth in GNP through FY2051 is unreliable.

#### **D. The EOM Makes Multiple Unreasonably Pessimistic Assumptions**

61. In addition to the flawed modeling framework used by the EOM, several key assumptions that go into the model are unreasonably pessimistic and not supported by data. In this section, I discuss how the EOM engineers the capital stock, one of its key inputs, to decline over time, and how it does not incorporate the growth impact of a specific productivity-boosting structural reform.

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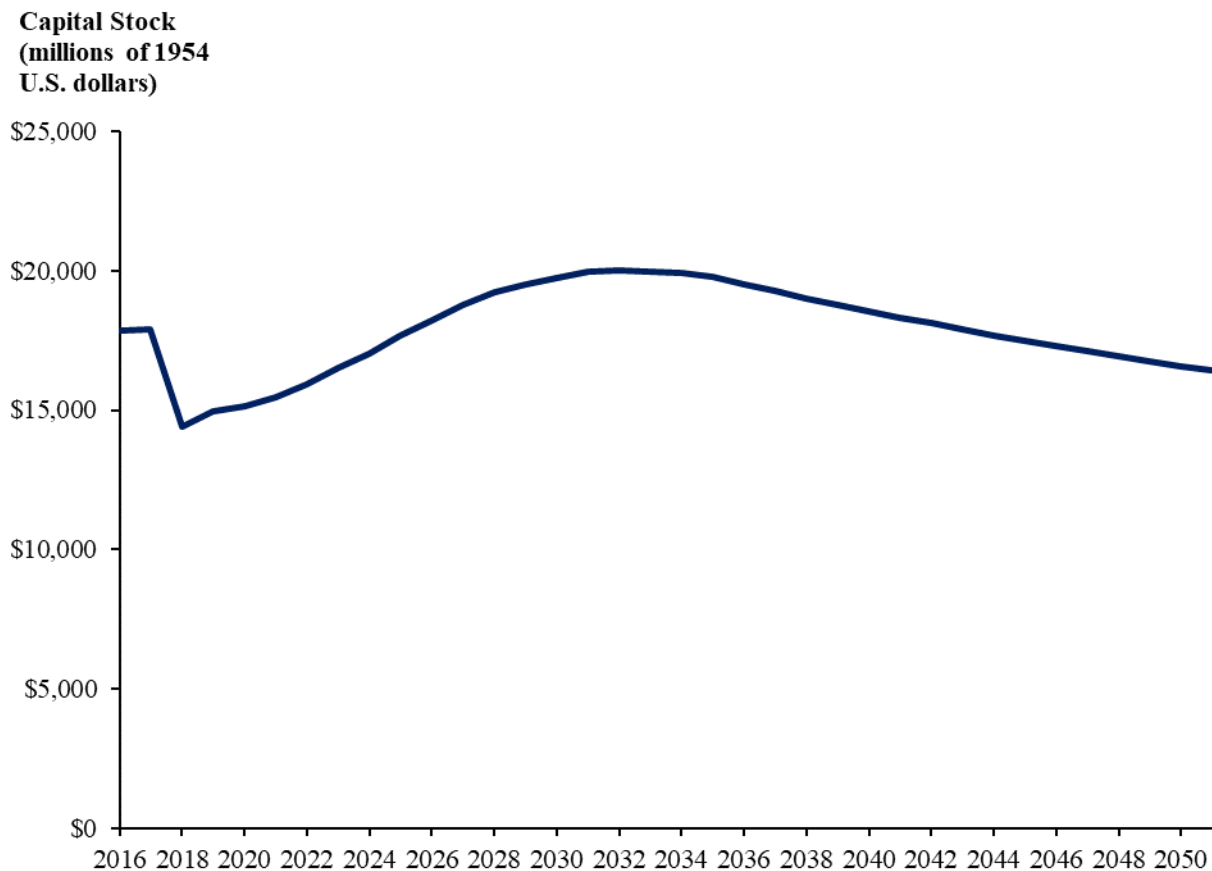
<sup>61</sup> See, e.g., Wooldridge, J.M., *Introductory Econometrics: A Modern Approach (5<sup>th</sup> Edition)*. (Mason: South-Western, Cengage Learning, 2013), at pp. 88-90.

<sup>62</sup> I was not able to perform any sensitivity or robustness analysis on the EOM's linear regression model because backup materials were not produced. I understand the Board produced certain backup materials related to the regression one day before this report was filed. I have not yet reviewed those materials.

1. *The EOM Assumes a Declining Capital Stock*

62. Of the “two most important factors of production” presented in Section IV.B.1, the EOM includes only one: capital stock. However, as shown in **Exhibit 8**, according to the EOM, after a steep drop in FY2018 to account for the damage from Hurricane Maria, the capital stock starts to recover, but then reverses trend and enters a long-term decline so that not only is Puerto Rico’s capital stock in FY2044 below its pre-hurricane value, but it declines another seven percent by FY2051.

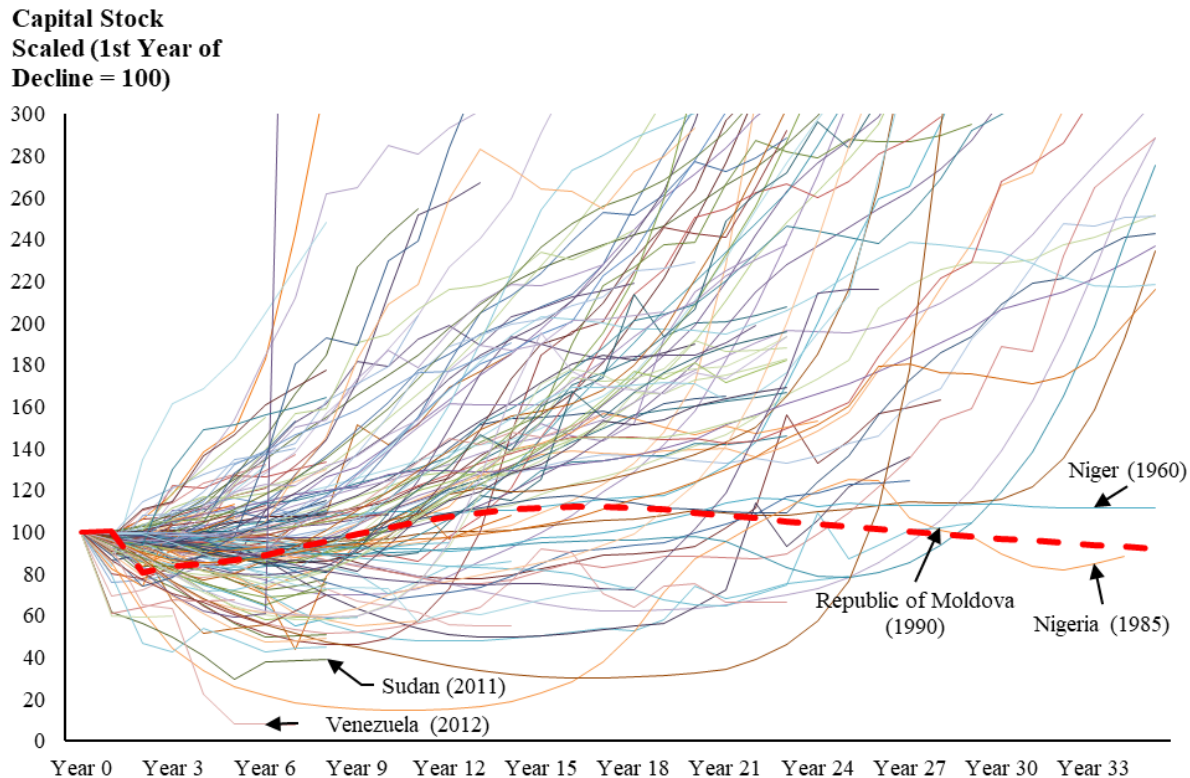
**Exhibit 8: EOM Historical and Projected Capital Stock FY2016–FY2051<sup>63</sup>**



<sup>63</sup> **Source:** 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”, Sheet “Macro Forecast”, Rows 15 and 189).

63. This type of stagnant growth followed by a long-term decline, were it actually to occur as forecast, would be unprecedented. In fact, however, the projected decline is driven by unreasonably pessimistic assumptions about investment and depreciation rates.

### Exhibit 9: Historical Path of Capital Stock for Countries that Ever Experienced a Decline in their Capital Stock<sup>64</sup>



<sup>64</sup> **Notes:** [1] The solid red line is Puerto Rico's historical capital stock and the dashed red line is Puerto Rico's forecasted capital stock as given in the 2022 Commonwealth Fiscal Plan. All other lines show historic capital stock for countries that ever witnessed a decline in their capital stock. [2] Year 0 corresponds to the first year of maximum decline for each country. For Puerto Rico, Year 0 is 2016 corresponding to the first year of available data in the 2022 Commonwealth Fiscal Plan. [3] Labeled countries have their Year 0 listed in parentheses. [4] 124 out of the 160 countries shown here (excluding Puerto Rico) had a last reported value greater than their Year 0 value. Of the 36 countries with a lower last reported value, only 8 have 10 years of data after Year 0. [5] Puerto Rico values from the 2022 Commonwealth Fiscal Plan correspond to fiscal years. Values for other countries from the World Bank correspond to calendar years. **Sources:** [A] Feenstra, R.C. et al., "The Next Generation of the Penn World Table," *American Economic Review*, 105, 10, 2015: 3150-3182. [B] 2022 Certified Commonwealth Fiscal Plan Excel Workbook ("January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx," Sheet "Macro Forecast," Row 189).

64. To put in context the EOM's assumed trajectory for capital stock, I analyzed historical capital stock trajectories for the period 1950-2019 across 180 countries. **Exhibit 9** shows the historical path of capital stock for the 160 countries from that data that ever experienced a decline in capital stock between any two years in a 30-year time span. All capital stocks are indexed to 100 in the first year of decline so that they are comparable.

65. The EOM's projection of Puerto Rico's capital stock is shown in red, and it is an obvious outlier. In fact, with the exception of Nigeria, no country has ever started to recover from an initial decline in capital stock and then reversed trend into a steady decline for so long.<sup>65</sup>

66. The EOM divides total capital stock into two series—"capital stock, unrelated to storm" and "capital stock funded by reconstruction"—that are projected separately and then combined to produce "real capital stock after reconstruction spending."<sup>66</sup> The two main drivers of projected capital stock are the EOM's assumptions about investment (which increases capital stock) and depreciation (which decreases it). The EOM assumes the same depreciation rate for both series of capital stock. That depreciation rate starts at 6.36 percent in FY2018 and increases linearly to 7.96 percent in FY2051. The EOM also reduces capital stock, by \$3.9 billion in

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<sup>65</sup> Other countries with a relatively long decline in their capital stock had faced significant political turmoil and yet their decline was shorter than the one projected for Puerto Rico. For instance, Nigeria's capital stock began declining in 1985. This decline in one of Africa's largest and most populous countries followed a political coup that overthrew the government in 1983, and then again in 1985, and caused political instability through 1999. Moldova's capital stock declined between 1990 and 2011. The beginning of the decline in Moldova's capital stock happened at the same time that the country unilaterally declared independence from the Soviet Union, leading to militant fighting and instability. ("Nigeria profile – Timeline," *BBC*, February 18, 2019. Accessed April 19, 2023, < <https://www.bbc.com/news/world-africa-13951696>>; "Moldova country profile," *BBC*, February 20. Accessed April 19, 2023, < <https://www.bbc.com/news/world-europe-17601580>>)

<sup>66</sup> 2022 Certified Commonwealth Fiscal Plan Excel Workbook ("January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx"), Sheet "Macro Forecast," Cells C183, C186, and C189.



FY2018 and \$158 million in FY2020, to capture the effect of damage caused by natural disasters.<sup>67</sup>

67. Investment in capital stock related to reconstruction is based on contributions from disaster relief funding, which comes from various sources (e.g., Federal Emergency Management Agency, Community Development Block Grant Program, Infrastructure Investment and Jobs Act) and is put toward rebuilding buildings and utilities that were damaged in hurricanes and earthquakes in FY2018-FY2020.<sup>68</sup> **Exhibit 10** shows the amount that is added to capital stock funded by reconstruction in each year. Contributions peak in FY2027 and decline to zero by FY2036.

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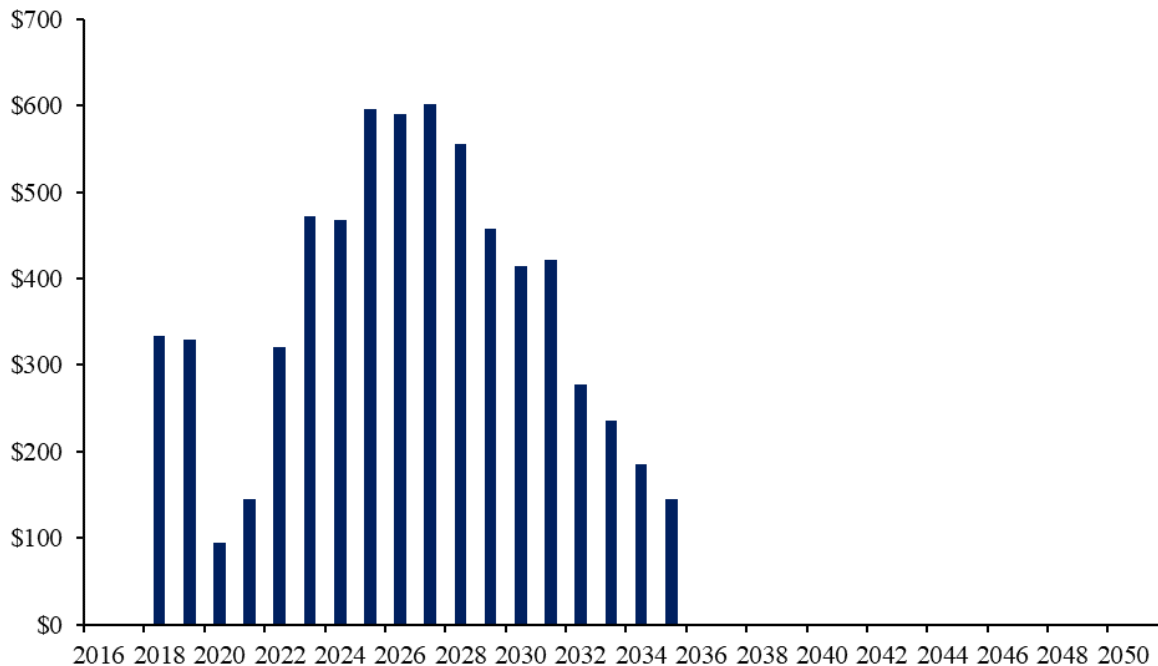
<sup>67</sup> 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”), Sheet “Macro Forecast,” Cells I181, K181.

<sup>68</sup> To contribute as investment in capital stock, the amounts from Disaster Relief Funding are deducted from a share of the funds (pass-through rates) that impact the economy through consumption of goods and services. The EOM assumes different pass-through rates for different types of funding. E.g., a 15.5% pass-through rate is assumed on \$26,749M of funding used to construct and repair utilities, 23.5% on \$32,349M of funding used to construct and repair residential, commercial, and school building, 23.5% on \$21,878M of funding directed towards programs and services. (See 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”), Sheet “DRF & Infrastructure,” Cells D16, D17, and D19) and 2022 Commonwealth Fiscal Plan, at p. 38).



### Exhibit 10: Projected Impact of Investment in Reconstruction on Capital Stock FY2016–FY2051<sup>69</sup>

Change in Capital  
Stock (millions of  
1954 U.S. dollars)



68. Annual investment in the other capital stock (“unrelated to storm”) is fixed at the FY2017 value of \$1.2 billion<sup>70</sup> for the entire projection period FY2018-FY2051. I find no reasonable basis for that long-term, zero-growth assumption. Zero growth in future investment is inconsistent with Puerto Rico’s historical experience, which shows that investment grew at an average annual rate of 2.8 percent since 1965.<sup>71</sup> Additionally, it is inconsistent with “ease of doing business reforms” that aim to attract new investments in Puerto Rico, as discussed in

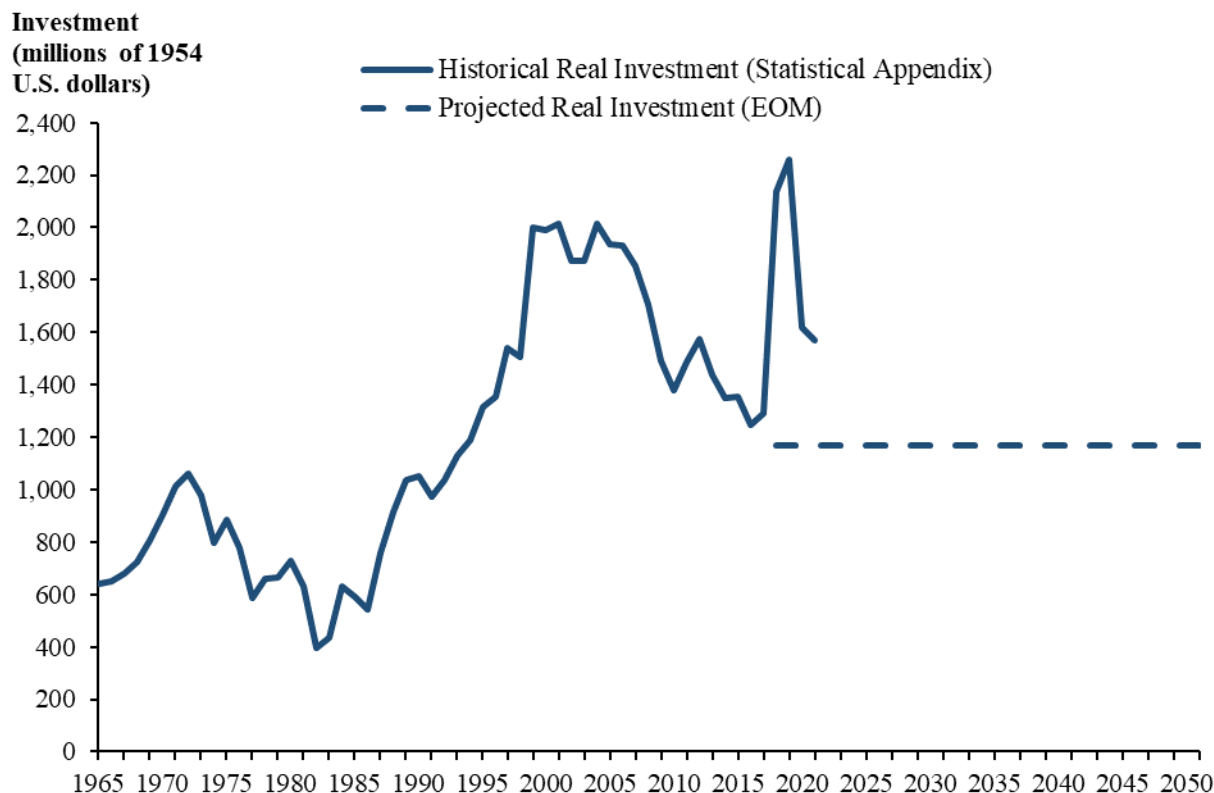
<sup>69</sup> **Source:** 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”, Sheet “Macro Forecast”, Row 185).

<sup>70</sup> The projected investment is below the actual value in FY2017 because the EOM relies on an outdated vintage of the Statistical Appendix.

<sup>71</sup> Investment surged in FY2018 following Hurricane Maria. Excluding this surge, the average annual growth rate of investment from FY1965 to FY2017 was 2.3 percent.

Section IV.A.2. **Exhibit 11** shows historical investment as a solid line and the EOM’s fixed projection of future investment as a dashed line.

**Exhibit 11: Historical and Projected Capital Stock FY 1965–FY2051<sup>72</sup>**



69. Even as the EOM assumes zero growth in new investment after 2017, the amount of capital stock that it removes through depreciation grows over time because of an increasing depreciation-rate assumption. The EOM purports to rely on a study by the International Monetary Fund that reports depreciation rates for high-income countries in 1960 and 2016, and

<sup>72</sup> **Notes:** [1] The average annual growth rate of Gross Domestic Investment during the period of 1965 to 2021 is 2.8 percent. [2] The Fiscal Plan forecasts Puerto Rico’s Gross Fixed Capital Formation to be constant at 1168.5 million (in 1954 USD) from 2018 to 2051. **Sources:** [A] Statistical Appendix of the Economic Report for the Governor and Legislative Assembly, 1975-2021, Table 3. [B] 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx,” Sheet “Macro Forecast,” Row 182).

assumes that the rates increased continuously over that time period, “from 2.5 percent in 1960 to 4.55 percent in 2016, and from 4.25 percent to 7 percent for government and private assets, respectively.”<sup>73</sup> The EOM projects forward linearly that same assumed trend of increasing depreciation rates through FY2049.<sup>74</sup>

70. Increasing rates of depreciation are associated with a transition from more basic technology, which depreciates more slowly, to more advanced technology, which tends to depreciate more rapidly.<sup>75</sup> For example, a concrete structure can last close to a century whereas computers have a lifespan of only a few years. So as an economy becomes more advanced and newer technologies (e.g., computers and software) form a larger share of its capital stock, the depreciation rate of the overall capital stock will tend to rise.<sup>76</sup>

71. However, the EOM applies the same increasing depreciation rate to the series of capital stock funded by disaster relief funding as for all other capital stock. But I would expect the depreciation rate of capital stock funded by DRF to be lower than the depreciation rate that applies to other capital stock. First, according to the EOM, these are public assets, which have a lower depreciation rate, and second, this capital stock consists of buildings and utilities, which are slower-depreciating assets than, for example, computers and software. Furthermore, an increasing depreciation rate assumption for capital stock funded by DRF is inappropriate

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<sup>73</sup> “Estimating Public, Private, and PPP Capital Stocks,” *IMF Fiscal Affairs Department*, May 2021. Accessed April 21, 2023, <[https://infrastructuregovern.imf.org/content/dam/PIMA/Knowledge-Hub/dataset/InvestmentandCapitalStockDatabaseUserManualandFAQ\\_May2021.pdf](https://infrastructuregovern.imf.org/content/dam/PIMA/Knowledge-Hub/dataset/InvestmentandCapitalStockDatabaseUserManualandFAQ_May2021.pdf)>, at p. 4.

<sup>74</sup> The EOM then uses the FY2049 depreciation rates in FY2050-FY2051.

<sup>75</sup> Kamps, C., “New Estimates of Government Net Capital Stocks for 22 OECD Countries, 1960-2001,” *IMF Staff Papers*, 53, 1, 2006, at pp. 130-131.

<sup>76</sup> “Estimating Public, Private, and PPP Capital Stocks,” *IMF Fiscal Affairs Department*, May 2021. Accessed April 21, 2023, <[https://infrastructuregovern.imf.org/content/dam/PIMA/Knowledge-Hub/dataset/InvestmentandCapitalStockDatabaseUserManualandFAQ\\_May2021.pdf](https://infrastructuregovern.imf.org/content/dam/PIMA/Knowledge-Hub/dataset/InvestmentandCapitalStockDatabaseUserManualandFAQ_May2021.pdf)>, at p. 8.

because, rather than newer technologies forming a larger share of this capital stock over time, it will remain composed of buildings and utilities, year after year.<sup>77</sup>

72. To summarize, the EOM assumes (without adequate basis) that the investment dollars to increase capital stock remain constant while the dollars subtracted from that capital stock through depreciation continuously increase. Those two assumptions, especially in combination, yield a declining capital stock over the long-term. I find no economic evidence to support these two assumptions, either individually or taken together. The resulting net effect of capital-stock investments, on the one hand, and depreciation and damage on the other hand, are shown in **Exhibit 8**. Capital stock experiences a sharp decline in FY2018, grows until FY2032, and then declines for the remainder of the projection period. Again, that forecasted trajectory of declining capital stock would be virtually unprecedented.

2. *There is No Basis for the EOM's Assumption that Expected Infrastructure Reform Provides No Benefit*

73. The EOM's second unreasonably pessimistic assumption is that anticipated infrastructure reform in Puerto Rico will have no effect on economic growth. As discussed in Section IV.A.2, the EOM includes five structural reforms: Ease of Doing Business, Power Sector, Human Capital and Welfare, Education, and Infrastructure and Capital Investment. However, as shown in **Exhibit 3**, the EOM includes the incremental growth from only four of these five reforms, and fails to account for any growth driven by infrastructure reform, which

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<sup>77</sup> The EOM takes the extreme position of continuing to increase the depreciation rate of capital stock funded by DRF post-FY2023, even after no additional investment is added and the share of quickly depreciating assets *cannot* change. See 2022 Certified Commonwealth Fiscal Plan Excel Workbook ("January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx," Sheet "Macro Forecast," Rows 185 and 187).

aims to revitalize Puerto Rico’s transportation sector.<sup>78</sup> Although the 2022 Commonwealth Fiscal Plan notes that Infrastructure Reform “will improve the flow of goods, services, information, and people across the Island,”<sup>79</sup> the EOM nevertheless assumes—without explanation—that this reform will contribute absolutely nothing to economic growth.<sup>80</sup> But in fact, any infrastructure improvement will generate long-lasting efficiency gains that will resonate through the entire economy given the vital role of transportation to business development and prosperity.

74. Economic theory and empirical research show that public investments in infrastructure will add to economic growth, not just by increasing productivity,<sup>81</sup> but also by encouraging firms to invest (a mechanism known as “crowding-in”) and thus further increasing growth.<sup>82</sup> The EOM omits both the general productivity boost from planned infrastructure improvements and this additional crowding-in effect. And it does so even though both positive

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<sup>78</sup> 2022 Commonwealth Fiscal Plan, at Chapter 11.

<sup>79</sup> 2022 Commonwealth Fiscal Plan, p. 77.

<sup>80</sup> 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx,” Sheet “Baseline Assumptions,” Rows 54 and 62.

<sup>81</sup> See, e.g., Farhadi, M., “Transport infrastructure and long-run economic growth in OECD countries,” *Transportation Research Part A: Policy and Practice*, 74, 2015: 73-90 (“[A] 10% increase in the share of the transportation infrastructure expenditure increases the labour productivity of the OECD countries by 0.14 percentage point”). See also Khanna, R., and Chandan Sharma., “Does infrastructure stimulate total factor productivity? A dynamic heterogeneous panel analysis for Indian manufacturing industries,” *The Quarterly Review of Economics and Finance*, 79, 2021: 59-73 (“[An] aggregate measure of infrastructure stock suggests that 1 percent increase in the infrastructure measure results in TFP growth by 0.16 percentage points.”).

<sup>82</sup> Friedman, B.M., “Crowding Out or Crowding In? Economic Consequences of Financing Government Deficits,” *Brookings Papers on Economic Activity*, 1978, 3, 1978: 642-654; Eden, M. and A. Kraay, “‘Crowding in’ and the Returns to Government Investment in Low-Income Countries,” The World Bank, *Policy Research Working Paper*, 2014, <<https://doi.org/10.1596/1813-9450-6781>> (“[A]n additional dollar of government investment causes private investment to increase by around 2 dollars, and output by around 1.5 dollars.”).

effects are described in the 2022 Commonwealth Fiscal Plan.<sup>83</sup> I find no basis in the economic evidence for this assumption.

**E. Relevant Economic Indicators Strongly Suggest that Puerto Rico is well into Recovery from the Decline that Started in 2006**

75. It is apparent from the general downward trend of the EOM's projection (see **Exhibit 6**) that the EOM projects Puerto Rico's economy to decline year after year through 2051. Although the EOM shows a temporary rise in GNP in the short-term, it assumes that Puerto Rico will never recover from the economic downturn that began in 2006. In this section, I demonstrate that recent historical trends in various economic indicators do not support this hypothesis.

76. The beginning of Puerto Rico's economic decline in 2006 coincided with the phasing out of Section 936 of the U.S. tax code, which had provided tax exemptions for certain U.S. corporations with business operations in Puerto Rico.<sup>84</sup> Manufacturing of pharmaceuticals and other "high-profit, easily transportable items" were encouraged by this tax provision to locate and expand operations in Puerto Rico.<sup>85</sup> Shortly after its phase-out, Puerto Rico was also hit by the 2008 global financial crisis. A significant economic decline ensued, but more recent evidence points to a strong recovery that is well underway.

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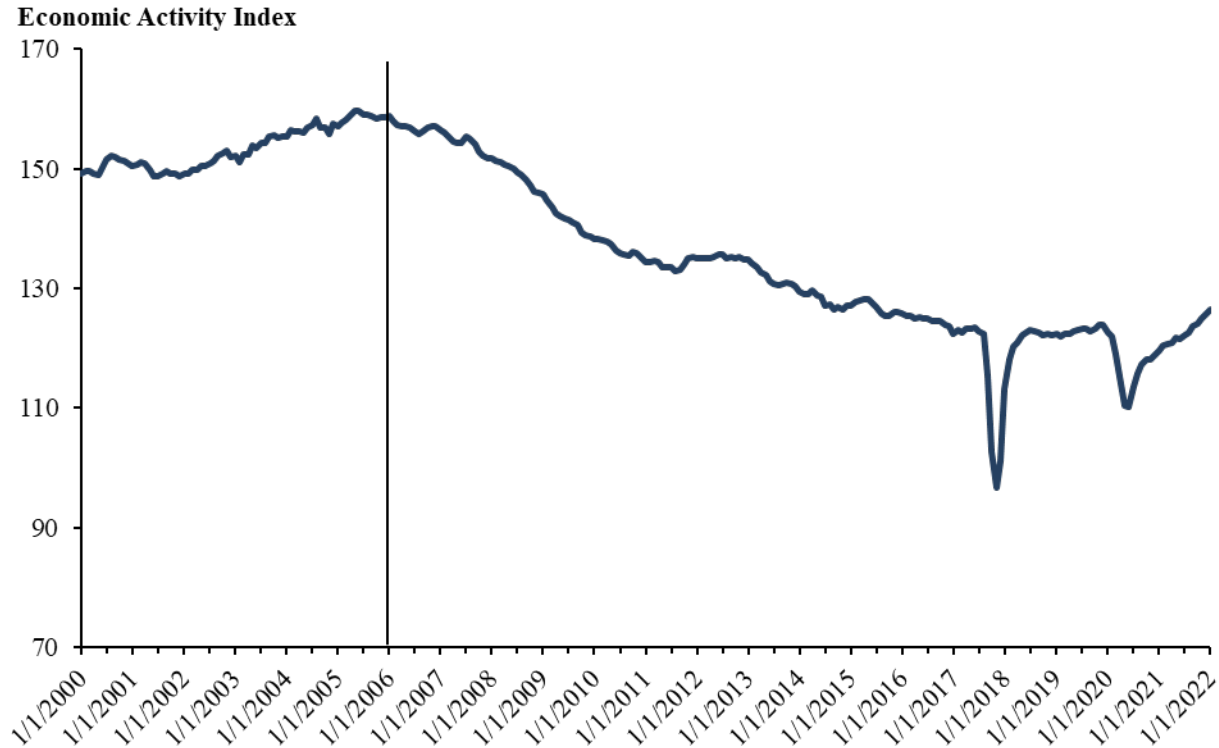
<sup>83</sup> 2022 Commonwealth Fiscal Plan, at p. 154 ("A well-performing [transportation] system can increase workers' access to jobs and businesses' access to customers, *unlocking the productive potential* of residents and firms, thereby increasing economic output and *inviting further private investment*," (emphasis added).)

<sup>84</sup> 2022 Commonwealth Fiscal Plan, at p. 19.

<sup>85</sup> Bram, J. et al., "Trends and Developments in the Economy of Puerto Rico," Federal Reserve Bank of New York, *Current Issues in Economics and Finance Second District Highlights*, 14, 2, 2008, at p. 3.

77. For example, **Exhibit 12** shows the Economic Activity Index published by Puerto Rico’s Economic Development Bank, and which in recent years has reversed trends despite major hurricanes, earthquakes, and a pandemic.<sup>86</sup>

**Exhibit 12: Economic Activity Index, January 2000–January 2022<sup>87</sup>**

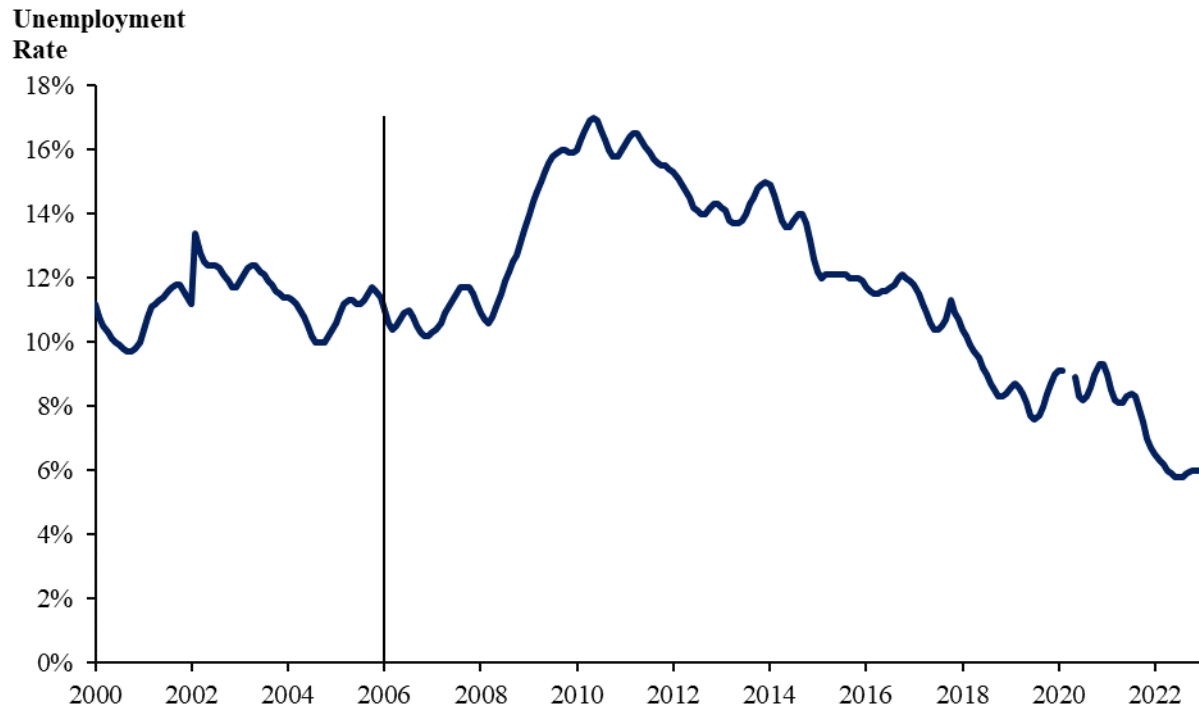


78. **Exhibit 13** shows unemployment, which has been steadily declining for over a decade and is currently near all-time lows.

<sup>86</sup> The Economic Activity Index is a monthly economic indicator that is highly correlated with Puerto Rico’s real GNP. See “The Puerto Rico Economic Activity Index (EDB-EAI),” March 30, 2023. Accessed on April 25, 2023, <<https://www.bde.pr.gov/BDE/PREDDOCS/EDB-EAI.pdf>>.

<sup>87</sup> **Source:** “The Puerto Rico Economic Activity Index (EDB-EAI),” March 30, 2023. Accessed on April 25, 2023, <<https://www.bde.pr.gov/BDE/PREDDOCS/EDB-EAI.pdf>>.

**Exhibit 13: Monthly Unemployment Rate, January 2000–February 2023<sup>88</sup>**

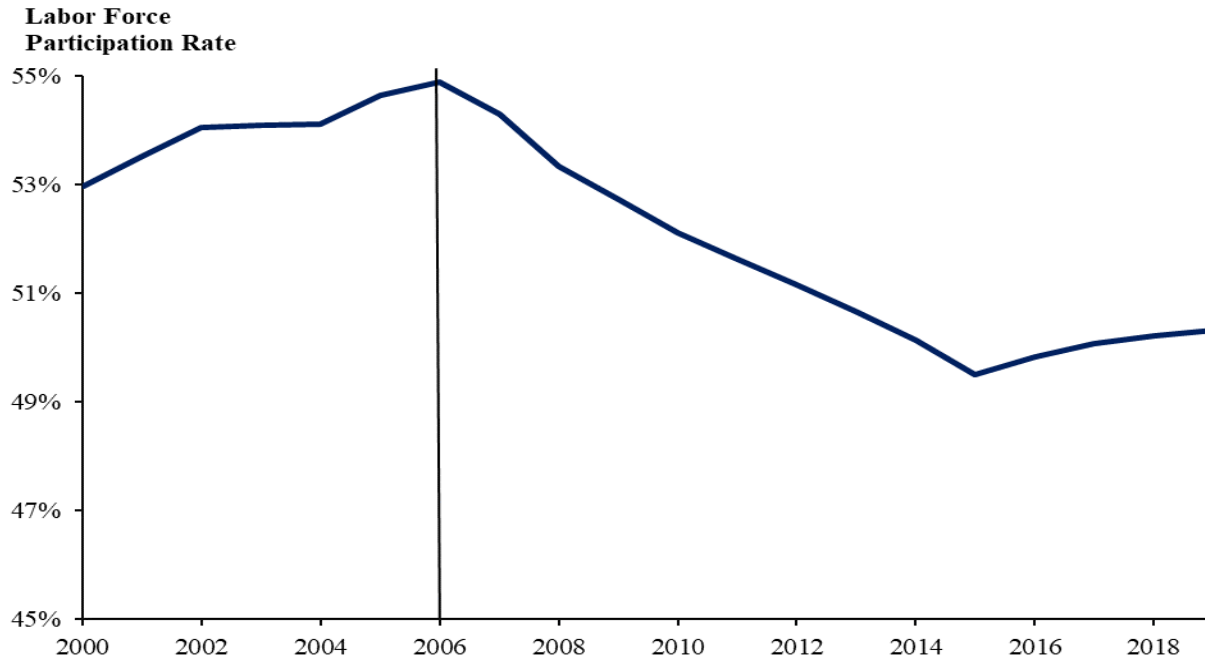


79. Importantly, part of the improvement in the labor market has been due to a growing labor force participation rate since 2015 (**Exhibit 14**), which signals an important structural recovery in the labor market.

<sup>88</sup> **Note:** Monthly Unemployment Rate for Puerto Rico from FRED is missing data for March and April of 2020.  
**Source:** “Unemployment Rate in Puerto Rico [PRUR],” *U.S. Bureau of Labor Statistics and FRED, Federal Reserve Bank of St. Louis*. Accessed April 24, 2023, <<https://fred.stlouisfed.org/series/PRUR>>.



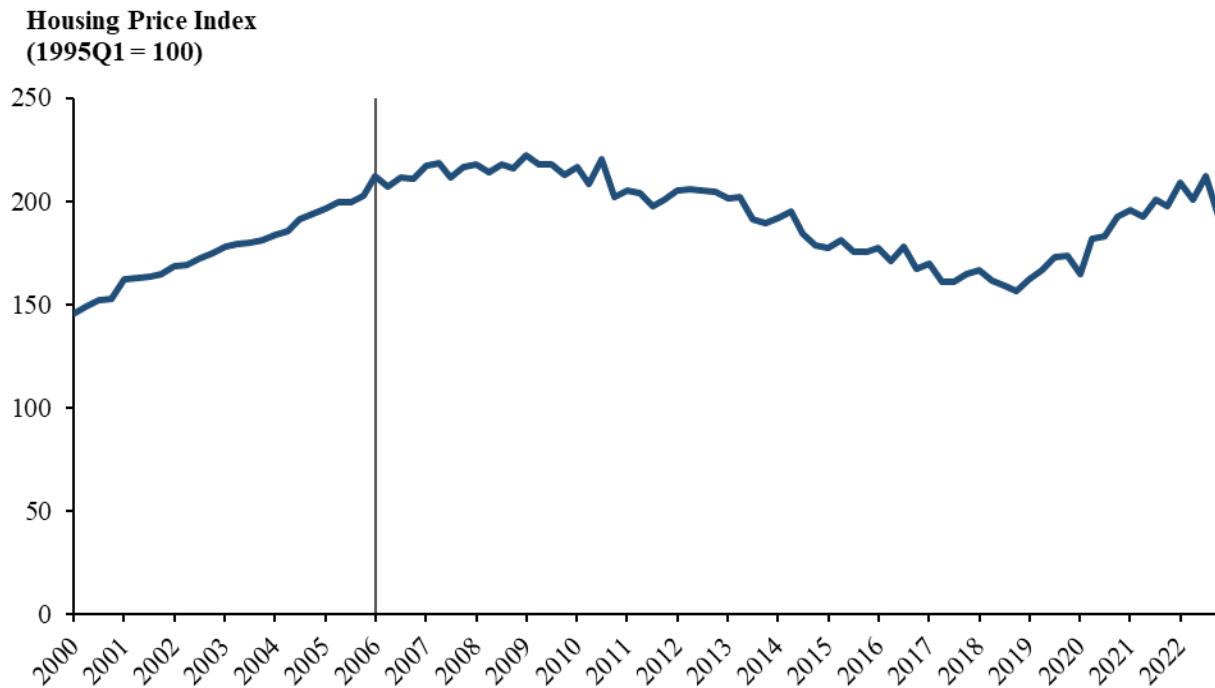
**Exhibit 14: Labor Force Participation Rate, Puerto Rico 2000–2019<sup>89</sup>**



80. **Exhibit 15** shows Puerto Rico’s Housing Price Index, which reveals that price declines that started during the global financial crisis have reversed course several years ago and began to increase.

<sup>89</sup> **Note:** The labor force participation rate corresponds to the population between the ages of 15 and 64 and is estimated by the International Labour Organization (ILO). **Source:** “World Development Indicators,” *The World Bank*, 2023. Accessed April 20, 2023, <<http://data.worldbank.org/data-catalog/world-development-indicators>>.

**Exhibit 15: Quarterly Housing Price Index in Puerto Rico 2000–2022<sup>90</sup>**

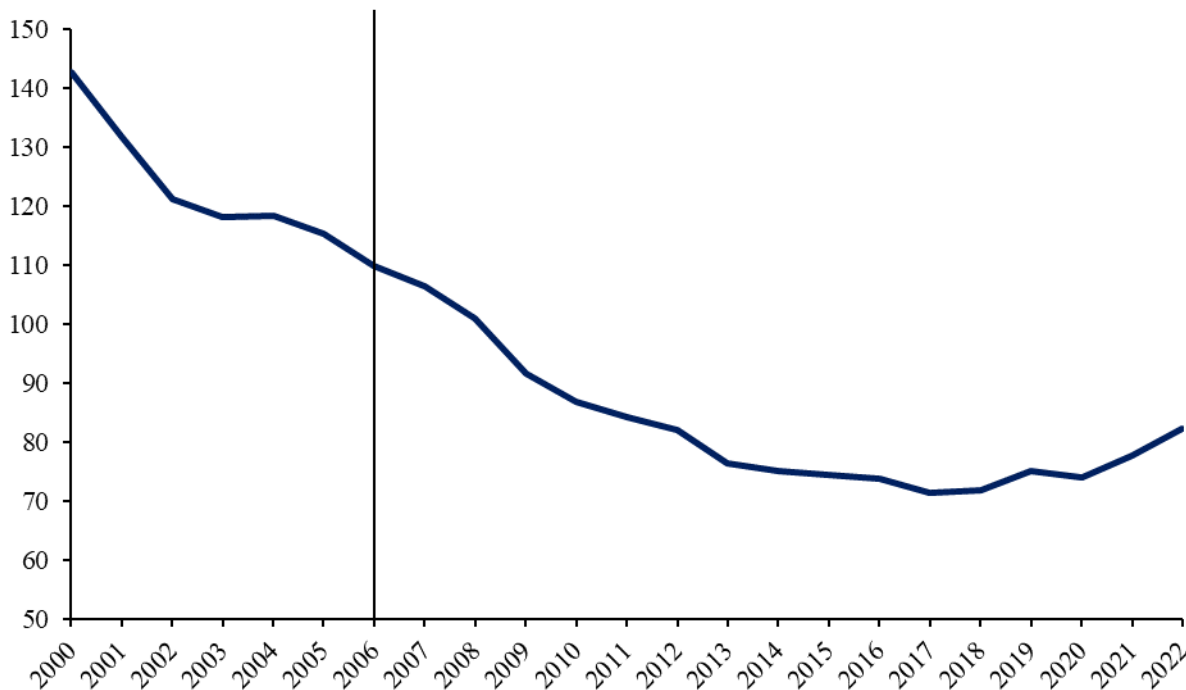


81. Lastly, even manufacturing employment has reversed its prior downward-sloping trend over the last several years (*see* **Exhibit 16**), which is inconsistent with the hypothesis that the 17-year-old repeal of Section 936 continues to affect manufacturing.

<sup>90</sup> **Note:** The Housing Price Index is estimated using sales prices and appraisal data, and it is not seasonally adjusted. **Source:** “House Price Index Datasets,” *Federal Housing Finance Agency*, 2023. Accessed April 21, 2023, <<https://www.fhfa.gov/DataTools/Downloads/Pages/House-Price-Index-Datasets.aspx>>.

### Exhibit 16: Manufacturing Employment, Puerto Rico 2000–2022<sup>91</sup>

Manufacturing  
Employment  
(Thousands)



82. These observations are consistent with a recent report from the New York Federal Reserve, which notes that Puerto Rico’s economic downturn ended in 2017. “Since then, the economy has been growing interrupted only briefly by a steep drop early in the pandemic [from which] the economy bounced back strongly.”<sup>92</sup> The report also notes that “as of mid-2022, private-sector employment was at a fifteen-year high” and Puerto Rico “has made great progress

<sup>91</sup> **Note:** Reported annual values are calculated by taking the average of manufacturing employment across all months of a given year. **Source:** “Puerto Rico Economy at a Glance,” *U.S. Bureau of Labor Statistics*, Manufacturing Excel Workbook (“SeriesReport-20230418200059\_ddd172.xlsx,” Sheet “BLS Data Series”, Rows 13-36). Accessed April 21, 2023, <[https://www.bls.gov/eag/eag.pr.htm#eag\\_pr.f.3](https://www.bls.gov/eag/eag.pr.htm#eag_pr.f.3)>.

<sup>92</sup> “Puerto Rico Economic Indicators,” *New York Federal Reserve*, April 19, 2023. Accessed April 20, 2023, <[https://www.newyorkfed.org/medialibrary/media/research/regional\\_economy/charts/Regional\\_PuertoRico](https://www.newyorkfed.org/medialibrary/media/research/regional_economy/charts/Regional_PuertoRico)> at p. 1.

in resolving and rebounding from its extensive fiscal crisis.”<sup>93</sup> Moreover, a recent presentation from the Puerto Rico Fiscal Agency and Financial Advisory Authority (AFAAF) highlighted Puerto Rico’s strong fiscal position and higher-than-expected revenue collections.<sup>94</sup> Government officials also recognize these changing trends.<sup>95</sup>

83. The economic indicators discussed above demonstrate that Puerto Rico is on the upswing of a recovery, rather than on a continued path of decline.

**F. The GNP Projection Underlying the Plan of Adjustment Fails to Account for Certain Growth-Generating Fiscal Policies Contained in the EOM**

84. I understand that the load projection that forms the basis for the Plan of Adjustment is based on an even lower GNP projection than the already-understated one that I have discussed above.<sup>96</sup> **Exhibit 17** shows, on the same graph, the EOM’s GNP projection (solid red line) and the even lower GNP projection relied upon by the Plan of Adjustment (dashed red line).

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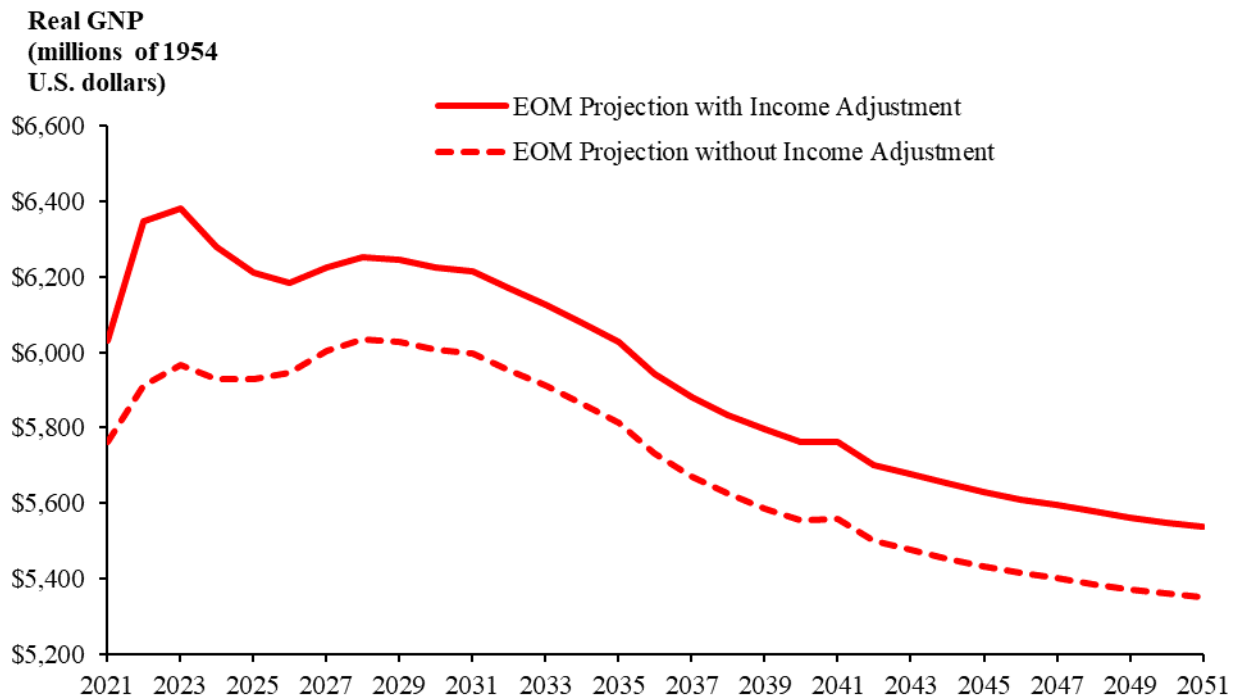
<sup>93</sup> “Puerto Rico Economic Indicators,” *New York Federal Reserve*, April 19, 2023. Accessed April 20, 2023, <[https://www.newyorkfed.org/medialibrary/media/research/regional\\_economy/charts/Regional\\_PuertoRico](https://www.newyorkfed.org/medialibrary/media/research/regional_economy/charts/Regional_PuertoRico)> at p. 1.

<sup>94</sup> See Marrero, O.J. “Investor Presentation Fiscal & Economic Progress Update,” Presentation at JP Morgan High Yield Conference, March 7, 2023, at p. 9 (“Since filing for Title III in 2017 Commonwealth cash levels have improved significantly, driven by General Fund revenue outperformance, expense measures and the moratorium on debt service payments, despite Hurricanes Irma and Maria, the 2019 and 2020 earthquakes and the COVID 19 pandemic.”) and p. 13 (“General Fund Net Revenues have grown at a 6.5% CAGR from FY 2017 through FY 2022 despite numerous catastrophes that have plagued the island over this time. Increased compliance in SUT, PIT and CIT have driven revenues to the highest ever in Puerto Rico.”).

<sup>95</sup> See Full Committee Meeting to Examine the State of the U.S. Territories,” Written Submission, *U.S. Senate Committee on Energy and Natural Resources, Government of Puerto Rico*, February 9, 2023. Accessed April 27, 2023, <<https://www.energy.senate.gov/services/files/A1843597-5C10-4578-B100-2261CDE0649A>> at p. 1 (Gov. Pierluisi proclaimed that Puerto Rico “has entered a new era of economic progress and optimism,” and noted that “all economic indicators have consistently been on the rise during the past two years.”).

<sup>96</sup> The GNP data used in the load projection underlying the Plan of Adjustment (See Tierney Expert Report, Appendix C) corresponds to the GNP data in Row 264 of the “Macro Forecast” Sheet in the 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom).xlsx”).

### Exhibit 17: Projections of Real GNP from the EOM Model FY2021–FY2051<sup>97</sup>



85. The 2022 Commonwealth Fiscal Plan explains that the lower projection omits the EOM’s modeling of both the income loss and the unemployment-insurance benefits related to COVID-19, which have a net positive effect on GNP, as shown by the solid line.<sup>98</sup> Neither the 2022 Commonwealth Fiscal Plan, the 2022 PREPA Fiscal Plan, nor the Plan of Adjustment or its

<sup>97</sup> **Note:** The EOM model’s real GNP projection without income adjustments is used by PREB (Puerto Rico Energy Bureau) for load forecasting. **Source:** 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx,” Sheet “Macro Forecast,” Rows 25 and 264).

<sup>98</sup> See 2022 Commonwealth Fiscal Plan, at p. 32 (“While economic activity was severely reduced, extraordinary unemployment insurance and other direct transfer programs more than offset the estimated income loss due to less activity. As a result, personal income has temporarily increased on a net basis. The 2021 Fiscal Plan incorporated a real growth series that was adjusted for these short-term income effects for the purposes of forecasting tax receipts. The increased level of income is associated with higher levels of consumption and income tax collection in the short-term. The 2022 Fiscal Plan maintains this adjustment.”). See also, Letter from Proskauer, *In re: The Financial Oversight and Management Board For Puerto Rico, as Representative of Puerto Rico Electric Power Authority*, No. 17-04780-LTS, dated April 17, 2023 (“Row 261 is produced by removing the net income effects from the COVID-era federal income support programs, which are explained on page 32 of the 2022 Fiscal Plan, and re-calculating the GNP growth series.”). I provide the values of both of these data series in **Appendix C**.

Disclosure Statement provide any explanation why these growth-generating contributions to the GNP forecast should be omitted from projections underlying the Plan of Adjustment.

**V. A SOLOW GROWTH MODEL IS BETTER SUITED TO MODELING PUERTO RICO'S FUTURE GNP AND PREDICTS A HIGHER AND MORE REASONABLE FUTURE TRAJECTORY**

86. I explain above (Section IV.C) why the linear regression methodology used by the EOM to project a future GNP trend line is both contrary to accepted methodology and unsuited to the task. In this section, I present the Solow Growth Model (“SGM”), which is an economic model that is commonly used for long-term economic projections and that does not suffer from the flaws affecting the EOM’s framework. At a high level, the SGM projects a future path of GNP based on the productive capacity of an economy, *i.e.*, how much output the economy can generate based on future available inputs. Such a future path of GNP is referred to as “Potential Output” and is similar to what the EOM’s trendline (discussed in Section IV.A.1) attempts to capture. Indeed, the EOM’s backup materials refer to the trendline growth rate as “*Potential* GNP growth.”<sup>99</sup>

87. The SGM directly incorporates productivity-boosting structural reforms into the estimate of Potential Output, rather than adding them in afterward, as the EOM attempts to do. As explained below, directly incorporating Puerto Rico’s structural reforms into a model of its Potential Output captures additional economic gains because higher output generates more capital stock, which in turn contributes to even higher output (and so on).

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<sup>99</sup> 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx”), Sheet “Macro Forecast,” Cell C140, emphasis added.

88. The SGM is a supply-side model and does not incorporate the short-term fluctuations captured by various fiscal policies (*see* Section IV.A.3) that affect aggregate demand and can push output above or below its “potential.” These types of policies are typically quantified using more complex simulation models with heavier data requirements, but for the purpose of exposition and ease of comparison, I adopt the EOM’s modeling assumptions and estimated impact of the fiscal policies (as described in Section IV.A.3). My adoption of these modeling choices facilitates a comparable forecast that includes the same considerations (including short-term impacts of fiscal policies). It does not imply that I believe these modeling choices to be reasonable—I have not received sufficient information at this time to be able to form an opinion on the EOM’s modeling of fiscal policies.

89. As discussed below, the assumptions I make for inputs into the SGM are conservative and, to the extent possible, rely on descriptions and calculations within the 2022 Commonwealth Fiscal Plan and the EOM. Combined with these assumptions, the SGM predicts a significantly more optimistic future trajectory for GNP compared to the one generated by the EOM.

#### **A. The Solow Growth Model Description**

90. The Solow Growth Model is a well-established and widely accepted methodology and the “starting point” for analyzing long-run growth.<sup>100</sup> This SGM methodology was developed by Robert Solow, who won the Nobel Prize in 1987<sup>101</sup> for his contributions to

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<sup>100</sup> Romer, D., “The Solow Growth Model,” *Advanced Macroeconomics* (4<sup>th</sup> Edition). (McGraw-Hill: New York, 2012), at p. 8 (“The Solow model is the starting point for almost all analyses of growth.”).

<sup>101</sup> “The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1987,” *The Nobel Prize*, 21 October, 1987. Accessed April 20, 2023, <<https://www.nobelprize.org/prizes/economic-sciences/1987/press-release/>>.

studying long-term economic growth.<sup>102</sup> Since that time, it has become the workhorse for analysis of growth and continues to serve as both the standard model used in economic research and for economic analysis by various reputable organizations around the world, including the Congressional Budget Office, the World Bank, and Goldman Sachs.<sup>103</sup>

91. The SGM identifies three primary drivers of long-run economic growth: capital, labor, and total factor productivity (“TFP”).<sup>104</sup> Labor refers to the size of the human labor force that is able and willing to work.<sup>105</sup> Capital refers to tools, machines, and other equipment used by the workers to generate output. TFP represents advances in productivity and a population’s understanding of the best ways to produce goods and services. Advancements in TFP can arise from various developments such as new tools and inventions (*e.g.*, light bulbs), or improvements in company organization (*e.g.*, the use of assembly lines in the production of vehicles).<sup>106</sup> These drivers of growth are modeled to interact in a dynamic system where, for example, an increase in

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<sup>102</sup> Solow, R.M., “A Contribution to the Theory of Economic Growth,” *The Quarterly Journal of Economics*, 70, 1, 1956: 65-94, at pp. 65–94.

<sup>103</sup> See “Long Term Growth Model (LTGM v4.3) - Model Description,” *The World Bank*. Accessed April 24, 2023, at p. 1 <. See also, Shackleton, R., “Estimating and Projecting Potential Output Using CBO’s Forecasting Growth Model,” *Congressional Budget Office*, Working Paper, 3, 2018, at p. 6. See also, Wilson, D., “Dreaming with BRICs: The Path to 2050,” *Goldman Sachs Global Economics Paper No. 99*, 2003 at p. 18.

<sup>104</sup> Caselli, F., “Accounting for Cross-Country Income Differences,” Aghion, P. and S. N. Durlauf (ed.), *Handbook of Economic Growth (Volume 1A)*. (Elsevier: North Holland, 2005), at p. 5; See also Acemoglu, D., “The Solow Growth Model,” *Introduction to Modern Economic Growth*. (Princeton University Press: Princeton, 2009), at p. 28.

<sup>105</sup> With more education and training, workers become more efficient. Subsequent versions of Solow-based growth models also incorporate the level of education, or “human capital,” of the population. (See *e.g.*, Caselli, F., “Accounting for Cross-Country Income Differences,” Aghion, P. and S. N. Durlauf (ed.), *Handbook of Economic Growth (Volume 1A)*. (Elsevier: North Holland, 2005), at p. 5).

<sup>106</sup> See, *e.g.*, Mankiw, N.G., “Production and Growth,” *Principles of Macroeconomics (6<sup>th</sup> Edition)*. (Mason: Thompson South-Western Cengage, 2012), at p. 240 (“A worker with only basic hand tools can make less furniture each week than a worker with sophisticated and specialized woodworking equipment.”), at p. 242 (“Technological knowledge takes many forms. Some technology is common knowledge—after one person uses it, everyone becomes aware of it. For example, once Henry Ford successfully introduced production in assembly lines, other carmakers quickly followed suit.”).



TFP generates more output, which in turn creates more investment that then spurs growth in the capital stock.

92. The SGM is used to project future GNP, based upon the interaction between these fundamental drivers of growth in a “production function.” The production function describes the relationship between the quantity of inputs and the quantity of output from production.<sup>107</sup> In the following paragraphs, I summarize how an economy’s evolution is modeled in the SGM.

93. At a high level, in the SGM, an economy evolves in the following way. First, given some level of output, or GNP, a portion is saved for investment and the remainder is consumed by the population. The amount saved for investment is used to increase capital, which also decreases each period due to depreciation.<sup>108</sup> The outcome of these opposing forces—investment and depreciation—generates the amount of capital available for production in the next period.

94. Labor is the number of workers available in any given period and is determined by several factors. Starting with the total population, the number of workers captures individuals that are actively participating in the labor market. The effectiveness of any number of workers may be augmented by gains from education, or human capital, as workers with higher education or more training are generally more productive.<sup>109</sup>

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<sup>107</sup> Romer, D., “The Solow Growth Model,” *Advanced Macroeconomics* (4<sup>th</sup> Edition). (McGraw-Hill: New York, 2012), at p. 10.

<sup>108</sup> In an open economy, domestic savings may be supplemented by foreign investment, which is how, for example, disaster relief funding can be captured in the model.

<sup>109</sup> See *e.g.*, Acemoglu, Daron. *Introduction to Modern Economic Growth*. (Princeton University Press: Princeton, 2009), at pp. 359–363.

95. The last input, TFP, represents the efficiency with which labor and capital are used in the economy. In other words, TFP tells us how much output a given amount of labor and capital will produce. Historically, productivity gains from advancements in technology and general knowledge have been substantial, allowing economies to produce vastly more goods and services with the same amount of capital and labor. For example, farming was once a very labor-intensive industry, employing a large portion of the population. Over time, advancements in knowledge (related to both mechanical technology as well as biotechnology) allowed the agricultural sector to drastically reduce its labor requirement while at the same time maintaining a high level of output.<sup>110</sup> In general, knowledge has grown and improved over time and this trend is expected to continue into the future. Moreover, knowledge improvements in one country are often transferrable to other countries, so the level of TFP within a country can continue to grow even if that country is not, itself, contributing to those advancements.

96. Once calculated, the quantities of labor and capital are combined with TFP in the SGM to generate output for the next period. Part of that output is saved and invested, the remainder is consumed, and the process is repeated.

**B. The Solow Growth Model with Reasonable Assumptions Projects a Higher Future Path for Puerto Rico's GNP**

97. Applying the SGM to Puerto Rico requires choosing a specific production function ("model specification") and estimating all the relevant model parameters and future paths of the inputs ("model parameterization"). I describe each of these components below.

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<sup>110</sup> Mankiw, N.G., "Production and Growth," *Principles of Macroeconomics (6<sup>th</sup> Edition)*. (Mason: Thompson South-Western Cengage, 2012), at p. 242 ("A hundred years ago, most Americans worked on farms because farm technology required a high input of labor to feed the entire population. Today, thanks to advances in farming technology, a small fraction of the population can produce enough food to feed the entire country.").

### 1. SGM Specification

98. Since its development, there have been many modifications of the SGM in the academic literature, which incorporate various adaptations of the original version of the model.<sup>111</sup> I use the version presented in the *Handbook of Economic Growth* and actively used by the World Bank and the Penn World Tables.<sup>112</sup> A richer data environment may warrant a more complex model, such as the one used by the U.S. Congressional Budget Office (CBO),<sup>113</sup> but given the data availability for Puerto Rico, the foundational SGM is most appropriate.

99. As mentioned above, to predict future output, the SGM relies on two equations that summarize: (1) a mathematical representation of the production function and (2) a mathematical representation of how capital stock changes over time (“the law of motion of capital”). The production function captures how workers utilize capital to produce output, as represented by the equation below:

$$\text{GNP} = \text{TFP} \times \text{Capital Stock}^{(\alpha)} \times (\text{Human Capital Index} \times \# \text{ Workers})^{(1-\alpha)}$$

100. In this equation, “TFP” is a measure of the overall level of knowledge and technology in the economy; “Capital Stock” refers to the level of capital in the economy; “# Workers” is the subset of the population that is both of working age and part of the labor force;

<sup>111</sup> See, e.g., Romer, D., “The Solow Growth Model,” *Advanced Macroeconomics* (4<sup>th</sup> Edition). (McGraw-Hill: New York, 2012).

<sup>112</sup> Caselli, F., “Accounting for Cross-Country Income Differences,” Aghion, P. and S. N. Durlauf (ed.), *Handbook of Economic Growth (Volume 1A)*. (Elsevier: North Holland, 2005). Inklaar, R. and M. P. Timmer, “Capital, labor and TFP in PWT8.0.” *University of Groningen*, 2013. Pennings, S., “Long Term Growth Model (LTGM v4.3) - Model Description,” *The World Bank*, May 12, 2020. Accessed April 24, 2023, <<https://thedocs.worldbank.org/en/doc/133191589476085869-0050022020/original/ModelOutlineV43.pdf>>. See also, Hall, R.E., and C.I. Jones, “Why do some countries produce so much more output per worker than others?,” *The Quarterly Journal of Economics*, 114, 1, 1999: 83-116.

<sup>113</sup> Shackleton, R., “Estimating and Projecting Potential Output Using CBO’s Forecasting Growth Model,” *Congressional Budget Office*, Working Paper, 3, 2018.

“Human Capital Index” is an education-based measure of worker efficiency; and “ $\alpha$ ” and “ $1-\alpha$ ” are the relative contributions of capital and labor, respectively, to the production process.

101. The second equation, the law of motion for capital, describes the dynamic evolution of the capital stock over time in response to both new investment as well as the depreciation of existing capital:

$$\text{Capital Stock } (t) = \text{Capital Stock } (t-1) \times (1 - \text{Depreciation Rate } (t)) + \text{Investment } (t)$$

102. In words, the amount of capital, or “Capital Stock,” available in the economy at any given time,  $t$ , is equal to the Capital Stock from the previous period ( $t-1$ ), minus any depreciation of that capital, plus any new additions to the Capital Stock, or “Investment,” in the current period ( $t$ ).

## 2. *SGM Parameters*

103. To make the SGM operational, the variables in the two equations described above need to be replaced with estimates of the values that they represent. I discuss how I obtain these estimates in the following paragraphs and include a summary in **Exhibit 18**.

**Exhibit 18: Summary of SGM Parameters<sup>114</sup>**

Parameter	Input	Source
<b>Capital Stock</b>		
[1] Initial Capital Stock (non-DRF) in FY2021	\$14,637.4	2022 Commonwealth Fiscal Plan
[2] Initial Capital Stock (DRF) in FY2021	\$796.1	2022 Commonwealth Fiscal Plan
[3] Investment (non-DRF)	Investment rate starts at 27.3% in FY2021 and decreases linearly to 23% in FY2026 and remains constant at 23%	Historical data on Investment to GNP ratio from Statistical Appendix
[4] Investment (DRF)	Public + private reconstruction funding	2022 Commonwealth Fiscal Plan
[5] Depreciation Rate (non-DRF)	Increases from 6.5% in FY2021 to 8.0% in FY2051	2022 Commonwealth Fiscal Plan
[6] Depreciation Rate (DRF)	Constant at 6.5%	2022 Commonwealth Fiscal Plan
<b>Labor</b>		
[7] Total Population	World Bank Projection for FY2021-FY2050 and the average 5-year growth rate is used to extrapolate for FY2051	World Bank
[8] Working-Age-to-Population Ratio	World Bank Projection for FY2021-FY2050 and the average 5-year growth rate is used to extrapolate for FY2051	World Bank
[9] Labor Force Participation Rate	Linearly increases from 50.3% in FY2021 to 57.3% in FY2051	World Bank for initial value; June 2018 Commonwealth Fiscal Plan for LFPR growth rate assumption
[10] Human Capital Index	WCDE projection of Average Years of Schooling and Returns to Schooling	Wittgenstein Centre Human Capital Data Explorer; Psacharopoulos, G and Patrinos, H. (2002)
[11] Labor Share of Output	78.8%	Shackleton (2018); 2021 Statistical Appendix
<b>Total Factor Productivity (TFP)</b>		
[12] Initial TFP in FY2021	1.24	Solved for using initial parameters in FY2021
[13] Growth Rate of TFP	Linearly increases from 0.5% in FY2022 to 1.0% in FY2051	CBO, BRICs, WB models

104. Capital and labor have different weights (exponents,  $\alpha$  and  $1-\alpha$ , respectively) representing their relative contributions to the production process. Economic theory suggests that these relative weights are equivalent to the relative shares of total income that go to each input.<sup>115</sup> Thus, following the standard approach,<sup>116</sup> I obtain the labor share of income ( $1-\alpha$ ) by estimating the portion of national income that goes to wages and salaries.<sup>117</sup>

105. The human capital index captures the “skills, education, competencies, and other productivity-enhancing characteristics embedded in labor” and it is calculated by using the “returns to education”—a measure of the impact on wages from additional years of schooling. I rely on the same sources as *The Handbook of Economic Growth* (and other organizations that use

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<sup>114</sup> **Sources:** [A] 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx,” Sheet “Macro Forecast,” Rows 183-186. [B] “Population estimates and projections,” *The World Bank*, 2023. Accessed April 21, 2023, <<https://databank.worldbank.org/source/population-estimates-and-projections>>. [C] “World Development Indicators,” *The World Bank*, 2023. Accessed April 20, 2023, <<http://data.worldbank.org/data-catalog/world-development-indicators>>. [D] Statistical Appendix of the Economic Report for the Governor and Legislative Assembly, 1975-2021. [E] 2018 Fiscal Plan for Puerto Rico as Certified by the Financial Oversight and Management Board, dated June 29, 2018. [F] “*Wittgenstein Centre Human Capital Data Explorer*,” Wittgenstein Centre Demography and Global Human Capital, 2023. Accessed April 20, 2023, <<http://dataexplorer.wittgensteincentre.org/wcde-v2/>>. [G] Psacharopoulos, G., and H.A. Patrinos, “Returns to Investment in Education A Further Update,” Policy Research Working Paper, The World Bank, September 2002. [H] Shackleton, R., “Estimating and Projecting Potential Output Using CBO’s Forecasting Growth Model,” *Congressional Budget Office*, Working Paper, 3, 2018. [I] Wilson, D., “Dreaming with BRICs: The Path to 2050,” *Goldman Sachs Global Economics Paper*, 2003. [J] “Long Term Growth Model (LTGM v4.3) - Model Description,” The World Bank. Accessed April 24, 2023, <<https://thedocs.worldbank.org/en/doc/133191589476085869-0050022020/original/ModelOutlineV43.pdf>>.

<sup>115</sup> See, e.g., Acemoglu, Daron. *Introduction to Modern Economic Growth*. (Princeton University Press: Princeton, 2009).

<sup>116</sup> See, e.g., Shackleton, R., “Estimating and Projecting Potential Output Using CBO’s Forecasting Growth Model,” *Congressional Budget Office*, Working Paper, 3, 2018.

<sup>117</sup> The labor share estimate is 78.8 percent, which is similar to labor share in the U.S. See, e.g., Acemoglu, Daron. *Introduction to Modern Economic Growth*. (Princeton University Press: Princeton, 2009), at p. 57.

this specific form of the model)<sup>118</sup> for estimates of the returns to education and the projections of the population's average years of schooling.<sup>119</sup>

106. I use the standard method to calculate the number of workers.<sup>120</sup> In this method, the number of workers represents the group of individuals that (i) can and (ii) do participate in the labor force. Starting with the total population, I use the working-age-to-population ratio (WATPR) to extract the number of workers that can participate in the labor force, *i.e.* excluding individuals that are generally considered too young to work (less than 15 years old) or of retirement-age (65 years old and older). Next, among individuals aged 15–64 (the “working-age population”), only those that actually participate in the labor market can be considered part of the labor force. Therefore, to get the number of workers, I apply the labor force participation rate (LFPR) to the working age population.

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<sup>118</sup> See Hall, R. E., & C. I. Jones, “Why Do Some Countries Produce So Much More Output per Worker Than others?,” *The Quarterly Journal of Economics*, 114, 1, 1999: 83-116, at p. 87 (“Human capital-augmented labor is given by  $[H = \exp(\phi(E)) \times \text{Labor}]$ . In this specification, the function  $\phi(E)$  reflects the efficiency of a unit of labor with  $E$  years of schooling relative to one with no schooling[.]”), and p. 89 (“[W]e assume that  $\phi(E)$  is piecewise linear.”); Caselli, F., “Accounting for Cross-Country Income Differences,” Aghion, P. and S. N. Durlauf (ed.), *Handbook of Economic Growth (Volume 1A)*. (Elsevier: North Holland, 2005), p. 7 (“To construct human capital . . . the average years of schooling in the population over 25 years old . . . is turned into a measure of [Quality-adjust labor] through the formula:  $[\text{Quality-adjust labor} = \exp(\phi(\# \text{ of Years of Schooling})) \times \text{Labor}]$ , and the function  $[\phi(\# \text{ of Years of Schooling})]$  is piecewise linear”); *Also see* “Long Term Growth Model (LTGM v4.3) - Model Description,” *The World Bank*. Accessed April 24, 2023, <<https://thedocs.worldbank.org/en/doc/133191589476085869-0050022020/original/ModelOutlineV43.pdf>>.

<sup>119</sup> I obtain estimates for returns to education from Psacharopoulos, G., and H.A. Patrinos, “Returns to Investment in Education A Further Update,” Policy Research Working Paper, *The World Bank*, September 2002, at p. 14. For future average years of schooling, I obtain data from the Wittgenstein Center Data Explorer, which provides a “medium” projection of educational attainments for the population of individuals that are at least fifteen years old. *See also* “Wittgenstein Centre Human Capital Data Explorer,” *Wittgenstein Centre Demography and Global Human Capital*, 2023, Accessed April 20, 2023, <<http://dataexplorer.wittgensteincentre.org/wcde-v2/>>. The Wittgenstein Center provides projections under two other scenarios: “rapid” and “stalled” development, which, relative to the “medium” scenario, are associated with higher and lower educational attainments. Although the “rapid” scenario would not be an unreasonable assumption for Puerto Rico’s future based on the educational structural reforms discussed in Section [IV.A.2], I choose the more conservative “medium” scenario. The projection is provided at five-year increments through 2055 and I interpolate the data points to generate an annual series.

<sup>120</sup> *See* “Long Term Growth Model (LTGM v4.3) - Model Description,” *The World Bank*. Accessed April 24, 2023, <<https://thedocs.worldbank.org/en/doc/133191589476085869-0050022020/original/ModelOutlineV43.pdf>>, at p. 1.

107. For the 15-64 age cohort, Puerto Rico’s LFPR was 50 percent in 2019, the most recent available estimate.<sup>121</sup> Puerto Rico’s LFPR is low relative to other countries.

**Exhibit 19: Puerto Rico’s LFPR Relative to  
Other Central American and Caribbean Countries<sup>122</sup>**

Country	Labor Force Participation Rate (LFPR)
<b>Central America and the Caribbean Average</b>	<b>69.92%</b>
1. Bahamas, The	81.46%
2. St. Lucia	79.14%
3. Barbados	77.73%
4. St. Vincent and the Grenadines	74.28%
5. Panama	72.16%
6. Virgin Islands (U.S.)	71.91%
7. Jamaica	71.38%
8. Costa Rica	71.15%
9. Dominican Republic	71.05%
10. Honduras	71.05%
11. Nicaragua	69.53%
12. Haiti	68.93%
13. Trinidad and Tobago	68.59%
14. Belize	67.71%
15. Guatemala	64.71%
16. Cuba	64.29%
17. El Salvador	63.15%
<b>18. Puerto Rico</b>	<b>50.32%</b>

<sup>121</sup> “World Development Indicators,” *The World Bank*, 2023. Accessed April 20, 2023, <<http://data.worldbank.org/data-catalog/world-development-indicators>>.

<sup>122</sup> **Notes:** [1] 2019 was used as it is the most recent year with data on labor force participation rate available in the World Bank Development Indicators database. [2] Data used is the Labor Force Participation Rate, total (% of total population ages 15-64) (modeled ILO estimate) as given by the World Bank. [3] Countries identified are those that are part of Central America and the Caribbean according to the Central Intelligence Agency World Factbook for which LFPR data is available for 2019 on the World Bank Development Indicators database. [4] The Average LFPR is calculated as the average of the LFPR of all countries listed. [5] The CIA lists Virgin Islands as part of Central America and the Caribbean, but the World Bank only has data on the part of it that is U.S. territory. **Sources:** [A] “World Development Indicators,” *The World Bank*, 2023. Accessed April 20, 2023, <<http://data.worldbank.org/data-catalog/world-development-indicators>>. [B] “The World Factbook — Central America and the Caribbean,” *Central Intelligence Agency*. Accessed April 21, 2023, <<https://www.cia.gov/the-world-factbook/central-america-and-the-caribbean/>>.

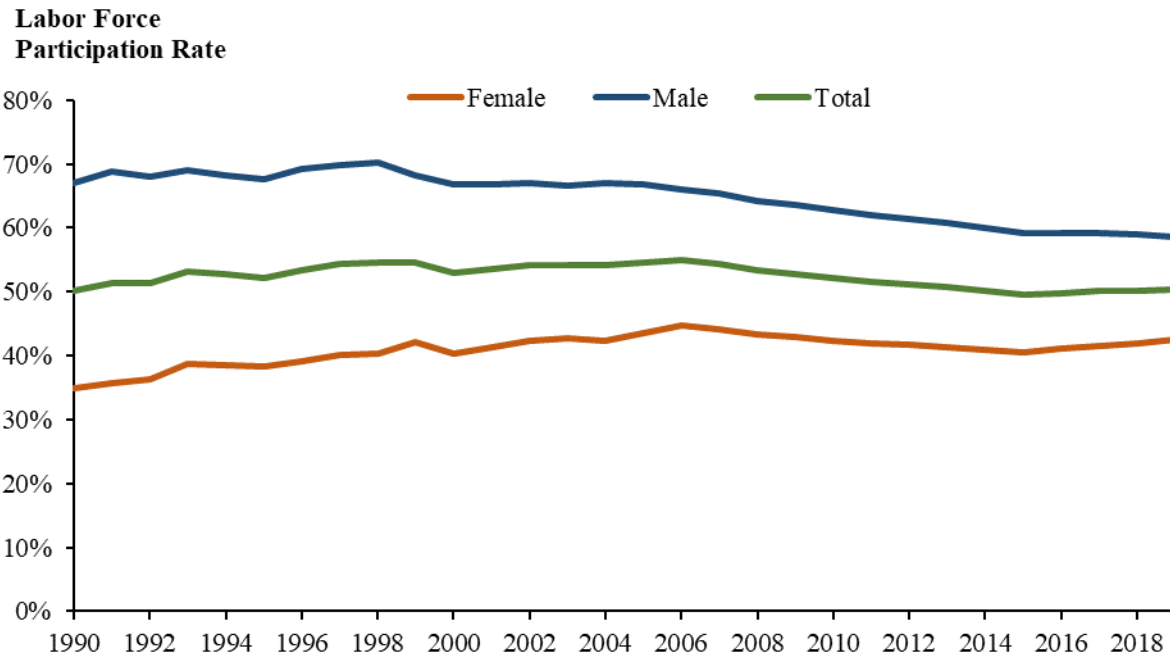


108. **Exhibit 19** shows Puerto Rico's LFPR relative to that of other Central American and Caribbean countries. Puerto Rico's LFPR is at the bottom of this list and, more generally, it ranks 168 out of 187 countries around the world for which data is available. Its LFPR is 18 percentage points below the world average, 23 percentage points below the U.S., and, as shown in **Exhibit 20**, historically, there exists a substantial gap between male and female LFPR. Economic evidence suggests that convergence of female LFPR to male LFPR can generate significant growth.<sup>123</sup>

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<sup>123</sup> See Ekrem, E., et al., "Female Labor Force Participation and Economic Growth: Theoretical and Empirical Evidence." *The Empirical Economics Letters*, 15, 10, 2016: 985-991, at p. 989 ("[A] 1% increase in female share of workforce brings a 0.57% increase in GDP per capita."); Thévenom, O., et al., "Effects of Reducing Gender Gaps in Education and Labor Force Participation on Economic Growth in the OECD." *OECD Social, Employment and Migration Working Papers*, 138, 2012, at p. 40 ("[A] potential gain of 12% to the size of the total economy by 2030" is predicted through the convergence in male and female labor force participation rates.); Luci, A., "Female Labour Market Participation and Economic Growth." *International Journal of Innovation and Sustainable Development* 4, 2-3, 2009: 97-108, at p. 3 ("Empirical investigations, for example by Klasen (1999), prove the positive impact of women's labour market participation on growth suggested by theory.").

## Exhibit 20: Labor Force Participation Rate in Puerto Rico by Gender 1990–2019<sup>124</sup>



109. These statistics demonstrate that Puerto Rico has substantial growth potential from improvements in LFPR, a conclusion that is reflected throughout the 2022 Commonwealth Fiscal Plan.<sup>125</sup> In addition, the 2022 Commonwealth Fiscal Plan describes specific reforms and provisions aimed at increasing LFPR and the 2023 Commonwealth Fiscal Plan attributes recent growth in LFPR to those policies.<sup>126</sup> To reflect the impact of these policies specifically targeting

<sup>124</sup> **Notes:** [1] The labor force participation rate series correspond to the population between the ages of 15 and 64 and are estimated by the International Labor Organization (ILO). [2] As of 2019, the male labor force participation rate was 58.6 percent, while the female labor force participation rate stood at 42.6 percent, creating a 16.0 percentage point gap between the two genders. [3] The latest available data for these series is from 2019. **Source:** “World Development Indicators,” *The World Bank*, 2023. Accessed April 24, 2023, <<http://data.worldbank.org/data-catalog/world-development-indicators>>.

<sup>125</sup> See, e.g., 2022 Commonwealth Fiscal Plan, at pp. 81-82 (“In 2020 Puerto Rico’s formal labor force participation rate [for the 16 and older age cohort] was on average 40.2%, among the lowest in the world and far below U.S. and Caribbean averages,” and “Puerto Rico’s labor force participation rate has ranked in the bottom-20 of more than 200 global economies since at least 1990 and in the bottom-15 since 2009.”).

<sup>126</sup> See, e.g., 2022 Commonwealth Fiscal Plan, at p. 47, describing one of the objectives of the Ease of Doing Business Reform (“Reduce occupational licensing requirements to facilitate labor force participation.”). See also, 2022 Commonwealth Fiscal Plan, at p. 84 (“The ARP Act establishes that, in order to qualify for this additional funding, Puerto Rico must: increase the percentage of earned income which is allowed as a credit for each group

LFPR, I allow LFPR to increase by 14 percent (to 57 percent) over 30 years (FY2022 to FY2051), which is half the increase that the 2022 Commonwealth Fiscal Plan sets as a target.<sup>127</sup> Despite evidence that LFPR has been increasing in the last few years, I conservatively set the LFPR for the start of the projection, in FY2022, to the 2019 value.<sup>128</sup> To put this assumption into context, it implies that after nearly three decades, Puerto Rico's LFPR would move up by only ten places from 168 to 157 out of 187 countries in the current worldwide ranking of LFPR.

110. I rely on the World Bank's projections of WATP, which is available through 2050.<sup>129</sup> To extend the forecast to 2051, I apply the average growth rate from the last five years.

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of recipients, in a manner designed to substantially increase labor force participation"). *See also*, 2022 Commonwealth Fiscal Plan at p. 84 ("Previous Fiscal Plans established that to effectively enhance labor force participation and reduce poverty through increased EITC benefits, the Government must more comprehensively promote the program for tax year 2020 and beyond."). *See also*, 2022 Commonwealth Fiscal Plan at p. 86 ("To further support labor force participation, the 2022 Fiscal Plan requires the Government to introduce a work/volunteer requirement for select adult NAP beneficiaries, with full implementation by the beginning of FY2024."). *See also*, 2022 Commonwealth Fiscal Plan at p. 88 ("To facilitate increased labor force participation, the 2022 Fiscal Plan requires that the Government take steps to more effectively train residents on the knowledge and skills needed to contribute to the economy."). *See also*, 2023 Commonwealth Fiscal Plan, Volume 1, at p. 15 ("In addition, labor force participation, despite being below other U.S. states, continues to rise. This increase is likely related in part to the recent expansion of the EITC program in 2021."). Both the 2022 and 2023 Commonwealth Fiscal Plans incorporate a "provision requiring the Government refrain from enacting new legislation that negatively impacts labor market flexibility," *see* 2023 Commonwealth Fiscal Plan, Volume 1, at p. 73.

<sup>127</sup> *See* 2022 Commonwealth Fiscal Plan, at p. 81 ("Puerto Rico has an opportunity to increase this [labor force participation] rate and must aspire to reach at least the rate of the lowest U.S. state (West Virginia, with 55%) [for the 15 years and older age cohort]..."). Similarly, The June 2018 Commonwealth Fiscal Plan, dated April 19, 2018, sets as a target for FY2023 of 47 percent for the LFPR for the 15 and up age cohort. *See* p. 39 ("The Government should **aim to increase the labor force participation rate to 47%** and reduce the youth unemployment rate to 20.2% by FY2023. In both cases, these results would roughly halve the current gap between Puerto Rico and the lowest U.S. state (West Virginia)," (emphasis added).) The most recent LFPR for that cohort is 41 percent (*see* Statistical Appendix of the Economic Report for the Governor and Legislative Assembly, 2021, Table 32), so reaching the target corresponds to a six percentage point (or 14 percent) increase. Rather than arriving at this target by FY2023, I conservatively assume that it will occur over the full projection period.

<sup>128</sup> More recent data for the 15 and older age cohort is available from the Statistical Appendix and reveals that the LFPR has increased from 2019 to 2021 from 40.7 percent to 41.3 percent (*see* Statistical Appendix of the Economic Report for the Governor and Legislative Assembly, 2021, Table 32).

<sup>129</sup> "Population estimates and projections," *The World Bank*, 2023. Accessed April 21, 2023, <<https://databank.worldbank.org/source/population-estimates-and-projections>>.

I also rely on the World Bank for the population projection, which is available for the same horizon and for which I make the same assumption to extend to 2051.<sup>130</sup>

111. As in the EOM, I model the overall level of capital in Puerto Rico as the sum of capital stock unrelated and related to disaster relief funding, which accommodates differing assumptions about the depreciation rates and investment that determine their evolution.<sup>131</sup>

I maintain the EOM's assumption for non-DRF capital stock depreciation, but consider a more appropriate, albeit conservative, assumption for the DRF capital stock depreciation rate.

112. As discussed in Section IV.C.1, DRF capital stock is directed towards buildings and utilities and does not undergo a significant change in composition to warrant an increasing depreciation rate.<sup>132</sup> In addition, estimates from the Bureau of Economic Analysis suggest that residential and non-residential structures, which are similar to the composition of DRF-related capital stock, depreciate at 2 percent, which is significantly lower than the EOM's assumption of 6.5-7.96 percent over the FY2022-FY2051 forecast period.<sup>133</sup> Nevertheless, I conservatively maintain the EOM's elevated depreciation rate of 6.5 percent for the start of the projection, but hold it fixed through FY2051.

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<sup>130</sup> 2022 Certified Commonwealth Fiscal Plan Excel Workbook ("January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx", Sheet "Population Support"). I cannot rely on the 2022 Commonwealth Fiscal Plan's population projection because it does not provide an estimate of the working-age population that is consistent with available estimates of LFPR. The World Bank—a reputable organization who I regularly rely on in my research and teaching—provides a population projection that is more recent and ensures consistency with the other model parameters.

<sup>131</sup> I also follow the EOM and augment the total level of capital stock with "Exogenous investment in post-reform economy," as discussed in Section IV.A.1.b.

<sup>132</sup> See 2022 Commonwealth Fiscal Plan, at p. 38 ("The 2022 Fiscal Plan posits that, based on how disaster relief funds are spent, these funds will impact the economy in various ways: to build the capital stock of the Island through **constructing and repairing buildings or utilities...**"), (emphasis added.)

<sup>133</sup> Inklaar, R. and M. P. Timmer, "Capital, labor and TFP in PWT8.0." *University of Groningen, 2013*, at Section 3, p. 6.

113. For investment into non-DRF capital stock, I use the standard approach and set the amount of investment equal to a fixed portion of GNP in each year.<sup>134</sup> The portion of GNP that is used for investment is determined by the investment rate, which I calibrate based on an analysis of Puerto Rico's own historical investment-to-GNP ratio alongside the investment-to-output ratios for high-income countries. I start the projection at the most recent available investment rate, 27.3 percent, and assume that it decreases in a straight line to 23 percent over the first five years, where it remains for the remainder of the projection period.<sup>135</sup> This long-term assumption is conservative as it is below Puerto Rico's historical 30-year average investment rate of 25.7 percent and below the average of the 30-year average for high-income countries (23.4 percent).<sup>136</sup> For the level of investment stemming from DRF, I use values from the EOM (see **Exhibit 10**).

114. For the initial values of both DRF and non-DRF capital stocks in FY2021, I adopt the EOM's estimate of the impact of the damage to capital stock from recent hurricanes and earthquakes.<sup>137</sup>

115. Next, total factor productivity (TFP) accounts for various policies and technological developments that make capital and labor more productive. I follow the standard

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<sup>134</sup> Caselli, F., "Accounting for Cross-Country Income Differences," Aghion, P. and S. N. Durlauf (ed.), *Handbook of Economic Growth* (Volume 1A). (Elsevier: North Holland, 2005).

<sup>135</sup> Statistical Appendix of the Economic Report for the Governor and Legislative Assembly, 1975-2021.

<sup>136</sup> The 30-year average for each high-income country was calculated using most recent data for countries that the World Bank classifies as high-income (all available years were used for countries with less than 30 years of data). See Statistical Appendix of the Economic Report for the Governor and Legislative Assembly, 1975-2021; "World Development Indicators," *The World Bank*, 2023. Accessed April 20, 2023, <<http://data.worldbank.org/data-catalog/world-development-indicators>>; "World Bank Country and Lending Groups," *The World Bank*. Accessed April 28, 2023, <<https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>>; World Development Indicators," *The World Bank*, 2023. Accessed April 20, 2023, <<http://data.worldbank.org/data-catalog/world-development-indicators>>).

<sup>137</sup> 2022 Certified Commonwealth Fiscal Plan Excel Workbook ("January 2022 Fiscal Plan Model Certified (Dataroom) .xlsx", Sheet "Macro Forecast," Row 181.

approach and solve for the initial level of TFP in Puerto Rico's economy by using estimates for all of the other components of the production function.<sup>138</sup>

116. TFP growth captures the productivity-related gains from Puerto Rico's structural reforms, improvements in infrastructure, and the general growth in technology (*e.g.*, due to new inventions and discoveries) around the world that is accessible to Puerto Rico. The CBO assumes a TFP growth rate of above one percent for the U.S., and the World Bank attributes a one percent TFP growth rate assumption to a "moderate" growth scenario. Other studies have also assumed growth rates in TFP above one percent over long time horizons,<sup>139</sup> and given Puerto Rico's future plans, a higher TFP growth rate would be warranted. Nevertheless, I conservatively set the TFP growth rate to increase in a straight line from 0.5 percent in FY2022 to one percent in FY2051 to capture the gradual roll-out of various structural reforms and rebuilding efforts.

### 3. *GNP Projection*

117. To generate a projection of GNP for Puerto Rico, I start with the SGM and combine it with the assumptions described in the previous section. The SGM generates a path of potential output for the economy, which is analogous to what the EOM's trendline based on a linear regression attempts to forecast. As discussed throughout this report, the SGM is better suited to this task for a multitude of reasons. The SGM is based on sound economic principles and not historical correlations that are unlikely to persist in the future. Furthermore, the SGM incorporates the effect of TFP and labor and allows them to dynamically generate capital stock.

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<sup>138</sup> To calculate initial TFP in FY2021, I re-arrange the production function and calculate the ratio of GNP to the weighted product of the factor inputs, *i.e.*, I solve for TFP. *See, e.g.*, Shackleton, R., "Estimating and Projecting Potential Output Using CBO's Forecasting Growth Model," *Congressional Budget Office*, Working Paper, 3, 2018, at p. 6.

<sup>139</sup> Wilson, D., "Dreaming with BRICs: The Path to 2050," *Goldman Sachs Global Economics Paper No: 99*, 2003, at p. 18.

Importantly, relative to the EOM, the SGM adopts more realistic, albeit conservative, assumptions about the depreciation of capital stock.

118. The SGM is a long-run model and omits the impact of short-run economic fluctuations that can push output to above or below potential, such as the effects of various fiscal policies. The EOM adds its estimate of these effects to the trendline generated by its linear regression (see Section IV.A.3). To make the SGM forecast comparable to the one produced by the EOM, I adopt the EOM's modeling assumptions related to fiscal policies.<sup>140</sup>

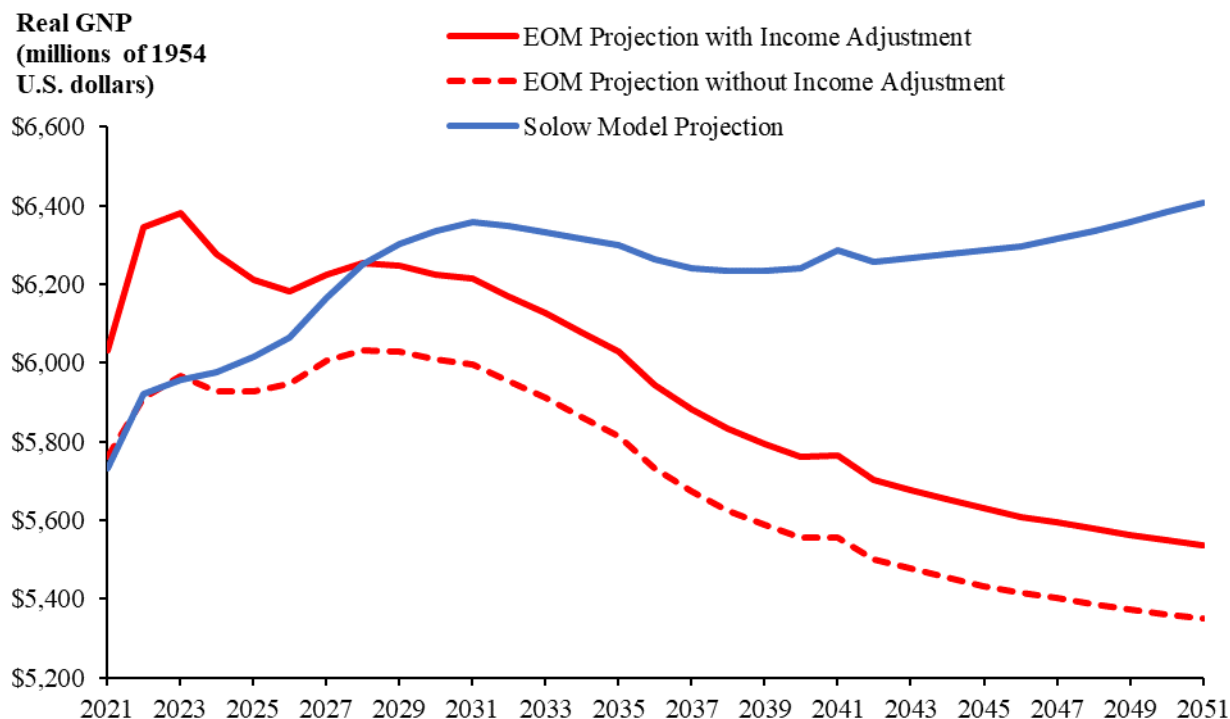
119. **Exhibit 21** shows, with the blue line, the projection from the SGM that incorporates the EOM's fiscal policy assumptions.<sup>141</sup> It also shows the EOM projection (red solid line) and the EOM projection that omits the COVID-19 income adjustment (red dashed line) that forms the basis for the Plan of Adjustment.

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<sup>140</sup> I note that my adoption of these assumptions is not in any way an acceptance of their suitability or adequacy—as mentioned before, I have not received sufficient backup materials to thoroughly evaluate them.

<sup>141</sup> I provide the values of these data series in **Appendix C**.

## Exhibit 21: GNP Projections from the Solow Growth Model and EOM FY2021–FY2051<sup>142</sup>



120. Even with very conservative assumptions, the SGM generates a drastically different economic outlook for Puerto Rico relative to the one produced by the EOM and relied upon by the Oversight Board. The SGM’s projection shows a continuing and steady economic recovery, which is consistent with the transformational policies planned for Puerto Rico, the recent evidence of trend reversals in various economic indicators and recent commentary from government officials, discussed in Section IV.E. That is, the SGM projects that, by FY2051, GNP will rise by an average annual growth rate of 0.4 percent, and end up 11.8 percent higher

<sup>142</sup> **Note:** The Solow model makes the following assumptions: the savings rate starts at an actual rate of 27.35% in FY2021 and linearly converges to 23% by FY2026, and remains at that level for the remainder of the projection. The labor share of income is 78.8%. The LFPR increases linearly from 50.32% in FY2021 to 57.26% in FY2051. The depreciation rate for non-DRF assets grows from 6.50% to 7.96%, while it remains constant at 6.50% for DRF assets, and the exogenous investments do not depreciate. The population projection is from the World Bank, and the TFP growth rate linearly increases from 0.5% in FY2022 to 1% in FY2051. **Source:** 2022 Certified Commonwealth Fiscal Plan Excel Workbook (“January 2022 Fiscal Plan Model Certified (Dataroom).xlsx,” Sheet “Macro Forecast,” Rows 25 and 264).



than it is in FY2021. The SGM also demonstrates that the GNP projection that serves as an input underlying the calculations in the Plan of Adjustment is unreliable, which contaminates the results presented in the Plan of Adjustment itself.

## **VI. AN UNJUSTIFIABLY LARGE HAIRCUT ON PREPA BONDS MAY HARM PREPA IN THE LONG RUN BY INCREASING ITS COST OF CAPITAL GOING FORWARD**

121. The Oversight Board's Plan of Adjustment contemplates a minimum haircut of 34 percent on PREPA's existing debt to bondholders.<sup>143</sup> In this section, I consider the extent to which imposition of a haircut of that magnitude can be expected to result in increases in PREPA's access to capital markets on reasonable terms in the future.

122. PREPA is a public utility—and the only public electric utility in Puerto Rico—so a helpful starting point for considering the potential impact of the recovery rate resulting from the Plan of Adjustment is the economic literature on sovereign debt restructurings. After describing the negative consequences associated with large debt reductions in sovereign debt markets, I then discuss how government influence over PREPA's policies could subject PREPA to similar consequences.

### **A. Unduly Large Debt Reductions Can Cause Reputational Damage and Impair Future Borrowing**

123. Leading economic theory predicts that sovereign default causes subsequent capital market exclusion, and that larger debt reductions restrict access to foreign funding for a

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<sup>143</sup> Disclosure Statement, Exhibit K, p. 10.

longer period of time.<sup>144</sup> Economic models also predict that upon re-entry to capital markets, debtors face higher borrowing costs due to a higher risk premium, which also increases with the size of the debt reduction.<sup>145</sup> The mechanism for these dynamics is driven by reputational damage: “[a] good repayment record assures access to credit in the future, while defaulting will be punished.”<sup>146</sup>

124. Economic models predict that only “inexcusable” or unjustified haircuts result in reputational damage, where inexcusable haircuts are debt reductions that are not justified by exogenous macroeconomic events.<sup>147</sup> If PREPA is capable of substantial or even full repayment of the PREPA bonds, then a haircut on the order of magnitude proposed by the Plan of Adjustment would be inexcusable.

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<sup>144</sup> Yue, V. Z., “Sovereign default and debt renegotiation,” *Journal of International Economics*, 80, 2, 2010: 176-187; Eaton, J., and M. Gersovitz, “Debt with Potential Repudiation: Theoretical and Empirical Analysis,” *The Review of Economic Studies*, 48, 2, 1981: 289-309; Kovrijnykh, N., and B. Szentes, “Equilibrium Default Cycles,” *Journal of Political Economy*, 115, 3, 2007: 403-446; Grossman, H. I., and J.B. Van Huyck, “Sovereign Debt as a Contingent Claim: Excusable Default, Repudiation, and Reputation,” *The American Economic Review*, 78, 1988: 1088-1097; Amador, M., and C. Phelan, “Reputation and sovereign default,” *Econometrica*, 89, 4, 2021: 1979-2010, at p. 2000 (“A government that defaults loses its reputation, and it takes periods of borrowing and not defaulting to eventually restore it.”); Amador, M. and C. Phelan, “Reputation and partial default,” *National Bureau of Economic Research*, Working Paper 28997, 2021, at p. 2 (“[T]he benefit of a larger haircut is ... the wiping out of more debt... The cost . . . is . . . loss in reputation, and . . . [an] increase in future interest rates.”).

<sup>145</sup> Cruces, J. J., and C. Trebesch, “Sovereign defaults: The price of haircuts,” *American Economic Journal: Macroeconomics*, 5, 3, 2013: 85-117, at p. 87 (“The size of haircuts is a significant predictor of spreads for up to seven years after a restructuring.”) and p. 108 (“The spread increase associated with haircut size is also economically substantial, especially for years four to seven after a restructuring.”).

<sup>146</sup> Cruces, J. J., and C. Trebesch, “Sovereign defaults: The price of haircuts,” *CESifo*, Working Paper 3604, 2011, at p. 13. See also Eaton, J., and M. Gersovitz, “Debt with Potential Repudiation: Theoretical and Empirical Analysis,” *The Review of Economic Studies*, 48, 2, 1981: 289-309, at p. 304 (“borrowers who repudiate their debt face future exclusion from capital markets”).

<sup>147</sup> Grossman, H. I., and J.B. Van Huyck, “Sovereign Debt as a Contingent Claim: Excusable Default, Repudiation, and Reputation,” *The American Economic Review*, 78, 1988: 1088-1097, at p. 1088 (“[S]overeign debts serve at least in part to shift to lenders’ risks associated with verifiable events that affect the fortunes of the sovereign. This interpretation of sovereign debts also implies that lenders sharply differentiate excusable defaults, which are justifiably associated with implicitly understood contingencies, from debt repudiation, which would be unjustifiable and inexcusable.”), and p. 1097 (“[A] sovereign’s decision to validate lenders’ expectations about the servicing of its debts presumably depends mainly on the sovereign’s concern for its trustworthy reputation for debt servicing. A trustworthy reputation is valuable because it provides continued access to loans.”)

125. A seminal, empirical study by Cruces and Trebesch (2013) shows that larger haircuts are associated with longer-term exclusion from credit markets and higher future cost of credit.<sup>148</sup> Based upon an examination of 27 sovereign defaults between 1993 and 2010, the authors show that high-haircut countries experienced post-restructuring borrowing costs that are about 200bp higher than low-haircut countries.<sup>149</sup> Further, the authors compare countries with haircuts above and below 30% and note that re-access to credit markets could take more than twice as long for countries with larger haircuts.<sup>150</sup> Cruces and Trebesch conclude that “achieving a high degree of debt relief now can have benefits in the short-run, but may also imply worse borrowing conditions in the future.”<sup>151</sup>

126. The Cruces and Trebesch study is consistent with economic theory. Costly punishment of inexcusably large haircuts is necessary in sovereign debt markets because creditors lending to sovereigns have limited legal recourse, and the presence of an enforcement mechanism encourages lending.<sup>152</sup> The need for such a mechanism is thus tied to available

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<sup>148</sup> Cruces, J. J., and C. Trebesch, “Sovereign defaults: The price of haircuts,” *American Economic Journal: Macroeconomics*, 5, 3, 2013: 85-117, at p. 114 (“High creditor losses are associated with significantly higher post-restructuring spreads and longer periods of market exclusion.”).

<sup>149</sup> Cruces, J. J., and C. Trebesch, “Sovereign defaults: The price of haircuts,” *American Economic Journal: Macroeconomics*, 5, 3, 2013: 85-117, at pp. 101-102 (The authors identify high-haircut countries as countries that experienced haircuts higher than the median of 37%, including Argentina, Iraq, Ecuador, Seychelles, and Serbia & Montenegro). See Figure 3 (p. 101) and Table 2 (p. 97).

<sup>150</sup> Cruces, J. J., and C. Trebesch, “Sovereign defaults: The price of haircuts,” *American Economic Journal: Macroeconomics*, 5, 3, 2013: 85-117, at p. 109 (“On average, partial re-access takes just 2.3 years after cases with [haircuts less than] 30%, while the duration is more than twice as long (6.1 years) for cases with [haircuts more than] 30%,” such as Ecuador, Iraq, and Cote d’Ivoire.) See Table 2 (p. 97) and Online Appendix Table A2 (Online Appendix p. 6).

<sup>151</sup> Cruces, J. J., and C. Trebesch, “Sovereign defaults: The price of haircuts,” *American Economic Journal: Macroeconomics*, 5, 3, 2013: 85-117, at p. 114.

<sup>152</sup> Grossman, H. I., and J.B. Van Huyck, “Sovereign Debt as a Contingent Claim: Excusable Default, Repudiation, and Reputation,” *The American Economic Review*, 78, 1988: 1088-1097, at p. 1088 (“Private debts are subject to laws regarding bankruptcy and enforcement of collateral. Sovereign debts, in contrast, are above the law... [C]ases in which one sovereign or its agents seized the assets of another apparent sovereign ... involve infringement of sovereignty.”); Borensztein, E., and U. Panizza, “The Costs of Sovereign Default,” *IMF Staff Papers*, 56, 4, 2009: 683-741, at pp. 684-685 (“In the case of sovereign debt, creditor rights are not as strong as in

remedies, which differ by market. For example, in many jurisdictions, corporate debt has a straightforward legal mechanism to enforce repayment, or partial repayment (*e.g.*, through liquidation)<sup>153</sup> and, in municipal debt markets, mechanisms to enforce repayment are stronger than in sovereign debt markets, though not as strong as in corporate debt markets (*e.g.*, municipalities have greater protections from asset seizures).<sup>154</sup>

127. The observed dynamic at work in the sovereign debt context may extend to the present context, in which the Plan of Adjustment contemplates a haircut larger than the 30 percent threshold identified in the Cruces and Trebesch study discussed above. Because the ability of creditors of a municipal utility to enforce payment may be more limited than in the context of corporate debt, imposition by the utility of an inexcusably large haircut may likewise result in punishment by the credit markets. In concrete terms, that means that while a large

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the case of private debts. If a private firm becomes insolvent, creditors have a well-defined claim on the company's assets... In the case of a sovereign debt, in contrast, the legal recourse available to creditors has limited applicability because many assets are immune from any legal action[.]"), and at p. 685 ("[T]he literature sustains that sovereign debt markets are still viable because, if defaults are costly in some way to the borrowing country, there will be an incentive to repay debts, regardless of the effectiveness of legal recourse."); Amador, M., and C. Phelan, "Reputation and partial default," *National Bureau of Economic Research*, Working Paper 28997, 2021, at p. 2 ("[T]o ... choose a smaller haircut, there has to be a corresponding, and equal, cost to imposing a larger haircut.").

<sup>153</sup> Panizza, U. et al., "The Economics and Law of Sovereign Debt and Default," *Journal of Economic Literature*, 47, 3, 2009:651-698, at p. 659 ("[T]he main difference between corporate and sovereign debt is the lack of a straightforward legal mechanism to enforce repayment of the latter. In the event of default, legal penalties or remedies do exist, but they are much more limited than at the corporate level. This leads to the question of why debt nonetheless tends to be repaid, and why a sovereign debt market can exist. Much of the economic literature on sovereign debt has focused on this problem."), and p. 652 ("In the corporate world, debt contracts are enforced by the courts. A corporation cannot simply repudiate, *i.e.*, decide not to repay its debts. If it tried, it would be sued and the courts would force it to hand over assets to the creditor, restructure, or (in the limit) shut down and liquidate its remaining assets.").

<sup>154</sup> Shleifer, A., "Will the Sovereign Debt Market Survive?," *American Economic Review*, 93, 3, 2003:85-90, at p. 85 ("[C]reditor rights vis-à-vis defaulting U.S. municipalities are much greater than those of lenders vis-à-vis their defaulting sovereign borrowers."), and p. 86 ("In many U.S. states, municipalities are unlike corporations in that they cannot seek bankruptcy protection from creditors at all. In a few instances, municipalities can seek (and have sought) such protection, known as Chapter 9. This municipal bankruptcy procedure follows some of the principles of Chapter 11, but further weakens creditor rights.").

haircut may appear to be of benefit to the utility in the short run, it may result in higher or more onerous lending terms in the longer run.

128. As I discuss in the next section, whether a public utility like PREPA is likely to experience reputational damage—and, as a result, face increased future borrowing costs and capital market exclusion—depends on market perceptions about the ability to enforce repayments.

**B. The Commonwealth's Influence Over PREPA's Policies May Impact Market Perceptions About the Ability to Recover Loans**

129. The Commonwealth has a long and well-documented history of interfering with PREPA servicing its debt (and policy-making in general), including (i) refusal to pay its overdue balances; (ii) refusal to allow PREPA to increase rates to cover costs; (iii) involvement in management and personnel appointments; and (iv) sanctioning subsidies that reduce PREPA's revenues.<sup>155</sup>

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<sup>155</sup> Disclosure Statement, at p. 126 (“Exacerbating PREPA’s revenue collection challenges was the fact that the Commonwealth and its other instrumentalities are significant customers of PREPA. Due to their own financial difficulties, these entities were often unable to pay PREPA in a timely matter, and would often finance their own budget deficits by delaying payments to PREPA”), and p. 379 (“The Legislative Assembly [of Puerto Rico] has historically attempted to pass legislation that may interfere with, hinder, impede, or attempt to control, PREPA’s ability to restructure and the terms of any bond issuance or achieve PREPA’s transformation goals.”); 2022 PREPA Fiscal Plan, at p. 36 (“Government accounts and public corporations are a key driver of overall electricity sales revenue for PREPA. However, they are also a historically underperforming client base with regards to collections and pending receipts. Issues with municipality receipts and CILT reform notwithstanding, Commonwealth agencies and public corporations hold accounts payable to PREPA in excess of \$200 million for past due energy services”), and p. 21 (“Historically, management decisions have been subject to political influence and changes, leading to high management turnover, discontinuity in capital investment plans, and electric customer rates that were insufficient to cover [costs]”; “Political influence and a lack of continuity in decision making [is a] long-standing structural issue [that has] led to PREPA’s current financial and operational position.”); “Puerto Rico’s Public Utilities,” Financial Oversight and Management Board, *The Independent Investigator’s Final Investigative Report - Section V (2)*, August 20, 2018 (as referenced in the Disclosure Statement and available at the Oversight Board’s website). Accessed April 21, 2023, <<https://drive.google.com/file/d/19-lauVo3w9MPS03xYVe0SWhQin-Q6FEf/view?pli=1>>, (“[P]olitical influence directly impacted PREPA’s rates in a way that simultaneously kept the rates high and, yet, insufficient to cover operational expenses and capital improvement projects. PREPA’s base electricity rate had not increased from 1989 to 2016.”)

130. Several of these interferences have directly limited PREPA's revenues that are available to repay debts and the Plan of Adjustment introduces new subsidies that take additional funding away from PREPA (and increase the burdens PREPA imposes on its other customers). For example, the Plan of Adjustment proposes exemptions for certain customers from paying the fixed and volumetric charges "[t]o ensure the most vulnerable customers are not overly strained by the Legacy Charge[.]"<sup>156</sup> Who bears the burden of the cost of this subsidy is a policy choice, and the current proposal effectively reduces the debt repayment capacity of PREPA. Although such a policy choice reduces the expenses the Commonwealth would have incurred had *it* been required to fund the exemptions, it is not without consequence. If markets perceive this subsidy and other policies affecting PREPAs revenues as political obstructions to PREPA's debt repayment, then PREPA may face significant repercussions for its ability to raise funds in the future.

131. These observed effects would impose tangible costs on PREPA in response to any perception that bondholders were subjected to an inexcusably large haircut. Those costs would take the form of exclusion from, or increased costs to access, the credit markets.

## **VII. THE COMMONWEALTH'S SUBSIDIZATION POLICIES CREATE MARKET DISTORTIONS WITH NEGATIVE CONSEQUENCES**

132. As discussed in the previous section, market perceptions of political interference in PREPA's management and policies could result in higher future borrowing costs as lenders would demand a higher rate of return to compensate them for the higher risk associated with

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<sup>156</sup> Disclosure Statement, at p. 40.

their loans. In this section, I present a basic model of supply and demand that shows reducing loan repayment to fund subsidies can have additional negative economic consequences.

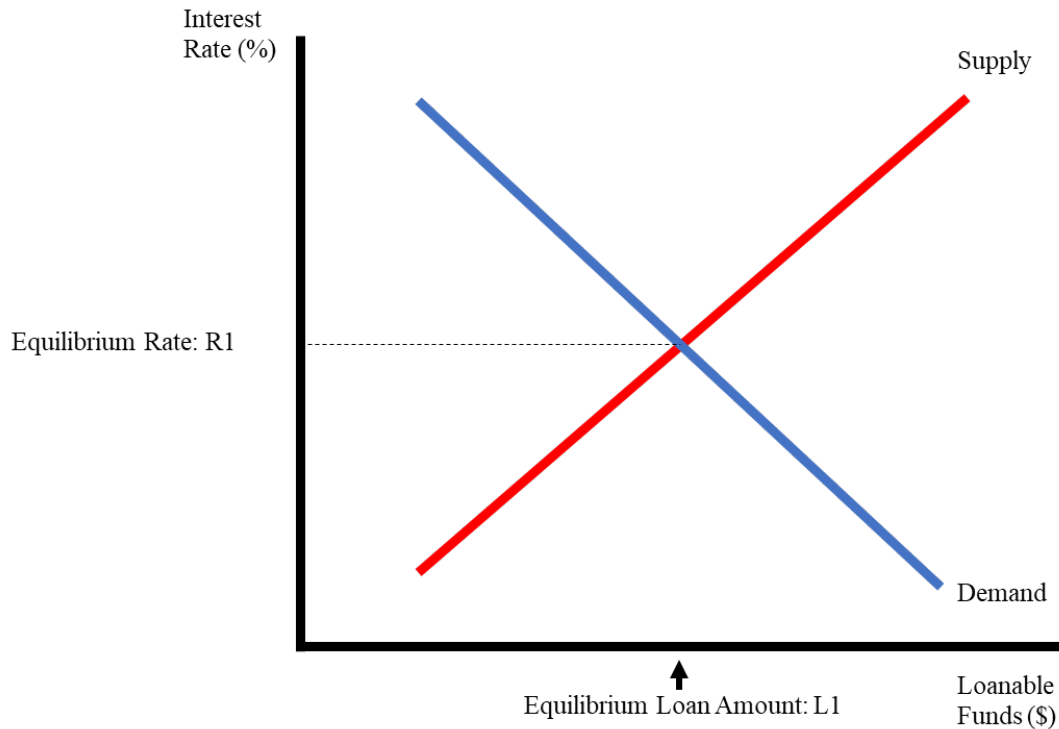
133. As mentioned above, the Commonwealth sanctions various subsidies that are funded by PREPA's collected revenues, effectively reducing PREPA's ability to service its debt. In effect, funds are being extracted from PREPA to pay for government policies that could otherwise be used for debt obligations. One way to assess the impact of such a policy is by analogy. As I explain below, this process is similar to taxing the lenders' rate of return on a loan and it creates significant market distortions.

134. The effect of a tax can be analyzed using a simple model of supply and demand for loans to PREPA, as shown in **Exhibit 22**.<sup>157</sup>

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<sup>157</sup> For a discussion of the equilibrium in a market for loanable funds, *see, e.g.*, Mankiw, N.G., *Principles of Macroeconomics (6<sup>th</sup> Edition)*. (Mason: Thompson South-Western Cengage, 2012), at pp. 268-270.

**Exhibit 22: Equilibrium Interest Rate and Loan Amount in Market for Loanable Funds**

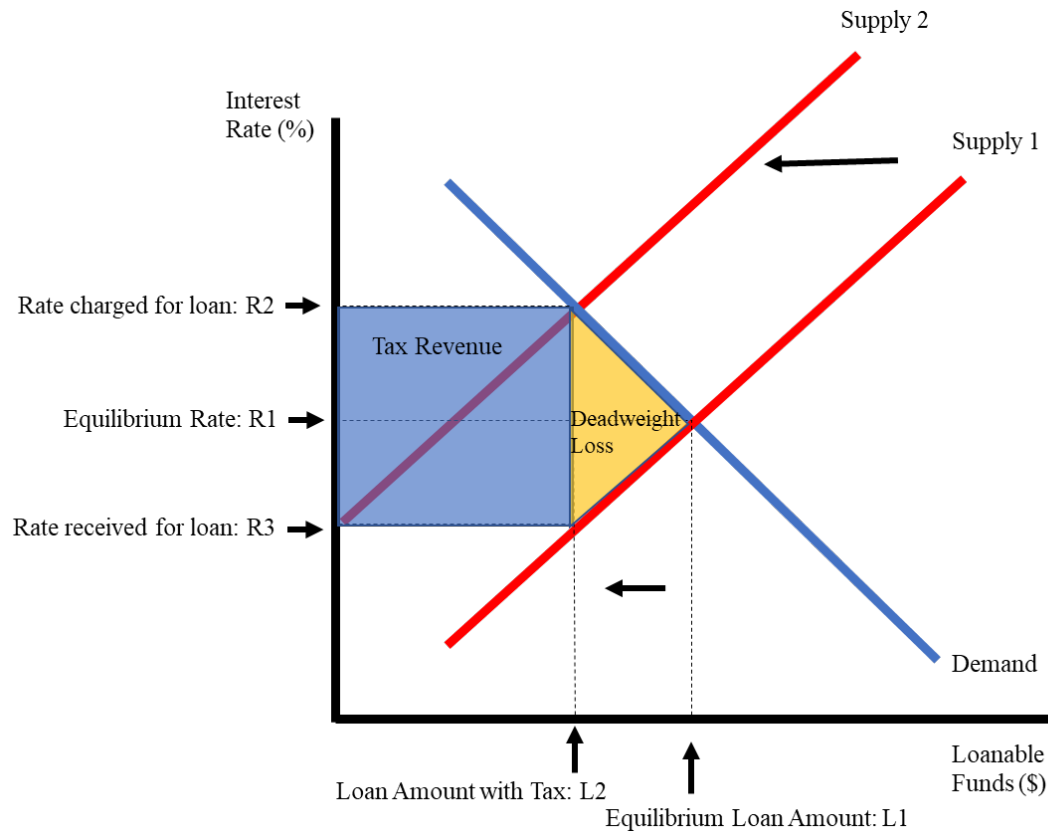


135. The blue line represents PREPA’s demand curve for debt. It slopes downward because the quantity of debt that PREPA demands increases as the interest rate (or price) it pays for these loans declines. The red line represents the creditors’ supply curve, which slopes up because lenders are willing to lend a higher amount of funds as the interest rate (or price) it receives for these loans increases. The two curves intersect at the point where the interest rate (R1) is such that the amount that creditors are willing to supply is equal to the amount that PREPA demands (L1).

136. **Exhibit 23** demonstrates what happens in that market for loanable funds when the government imposes a tax on the rate of return. Rather than receiving the equilibrium rate (R1), the lenders receive a lower rate (R3).



**Exhibit 23: Interest Rate and Loan Amount in Market for Loanable Funds with Tax**



137. The reduction in interest received by lenders causes a contraction in the supply, indicated by a leftward shift of the supply curve from Supply 1 to Supply 2. Even though the lenders only receive  $R_3$ , PREPA faces a higher interest rate of  $R_2$ , and the new intersection of the supply and demand curves occurs at a lower loan amount ( $L_2$ ).<sup>158</sup>

138. As shown in **Exhibit 23**, this tax is distortionary in that it reduces the size of the market that would exist without the presence of the tax (the loan amount  $L_2$  is smaller than  $L_1$ ). In addition to making the market less efficient, the tax also causes a reduction in welfare. In economics, welfare is typically measured by the amount that a consumer *is willing to pay* for a

<sup>158</sup> For a discussion of tax implications in equilibrium, *see, e.g.*, Mankiw, N.G., *Principles of Macroeconomics (6<sup>th</sup> Edition)*. (Mason: Thompson South-Western Cengage, 2012), Chapter 8.

good minus the amount that the consumer *actually pays* for the good (“consumer surplus”) and the amount that a supplier is paid for a good minus the cost of providing it (“producer surplus”).<sup>159</sup> In equilibrium, total welfare (the sum of consumer and producer surplus) is captured by the area under the demand curve and above the supply curve. When the tax is imposed, the total surplus, or welfare, is reduced by the amount of tax revenue generated by the tax (as shown by the blue rectangle).<sup>160</sup>

139. Importantly, the total reduction in welfare is greater than the amount of tax revenue generated. This additional reduction in welfare is called deadweight loss and is captured by the orange triangle in **Exhibit 23**. Because the presence of the tax causes lenders to lend less and the borrower to borrow less, the market shrinks below its optimal level and the surplus that would have existed without the tax no longer exists.

140. The Commonwealth’s policies of funding subsidies, by what effectively amounts to a tax on the rate of return on loans to PREPA, distorts the market by shrinking its size, reducing lender and borrower welfare, and creating a deadweight loss.

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<sup>159</sup> For a discussion of welfare and consumer and producer surplus, *see, e.g.*, Mankiw, N.G., Principles of Macroeconomics (6<sup>th</sup> Edition). (Mason: Thompson South-Western Cengage, 2012), Chapter 7.

<sup>160</sup> The area of the rectangle is equal to the dollar value of the loans times the tax imposed on the rate of the return.

Signed on the 28th day of April 2023 at Los Angeles, California

Sebastian  
Edwards

Digitally signed by  
Sebastian Edwards  
Date: 2023.04.27  
15:22:27 -07'00'

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Sebastian Edwards

## Curriculum Vitae

# **SEBASTIAN EDWARDS**

### EDUCATION

UNIVERSITY OF CHICAGO  
Ph.D. (Economics), 1981

UNIVERSITY OF CHICAGO  
M.A. (Economics), 1978

UNIVERSIDAD CATOLICA, CHILE  
Licenciado Economia, 1975  
Ingeniero Comercial, 1975

### ACADEMIC APPOINTMENTS

<b>2003-present</b>	<b>ANDERSON GRADUATE SCHOOL OF MANAGEMENT, UCLA</b> The Henry Ford II Distinguished Professor of International Economics.
<b>1996-2002</b>	<b>ANDERSON GRADUATE SCHOOL OF MANAGEMENT, UCLA</b> The Henry Ford II Professor of International Economics.
<b>1993-1996</b>	<b>THE WORLD BANK GROUP</b> Chief Economist for the Latin America and Caribbean Region.
<b>1990-1993</b>	<b>ANDERSON GRADUATE SCHOOL OF MANAGEMENT, UCLA</b> The Henry Ford II Professor of International Business Economics.
<b>1981-present</b>	<b>DEPARTMENT OF ECONOMICS, UCLA</b> Assistant Professor (1981-85), Associate Professor (1985-1988) Professor of Economics (1988-2003) Distinguished Professor (2003-present).

### AWARDS, PRIZES AND HONORS

Carlos Diaz Alejandro Prize for lifelong scholarly contributions to the study of Latin America, 2012

Inaugural Lecture, Universidad de Chile Faculty of Engineering, 2008

Corden Lecture, Australian National University, 2007

Figuerola Lecture, Universidad Carlos III, Madrid, Spain, 2006

Mundell-Fleming Lecture, International Monetary Fund, 2002

Inaugural Lecture, Kiel Institute World Economy, Kiel Germany, 2001

World Economy Lecture, University of Nottingham, 2000

## **OTHER PROFESSIONAL AND ACADEMIC ACTIVITIES**

**ANDERSON GRADUATE SCHOOL OF MANAGEMENT,**  
Senior Associate Dean of Global Initiatives, and Director Center for  
Global Management, 2012-present

**IAE, UNIVERSIDAD AUSTRAL, ARGENTINA, 2000-2004**  
Profesor Extraordinario

**NATIONAL BUREAU OF ECONOMIC RESEARCH (NBER)**  
Research Associate, 1981-present

**LATIN AMERICAN AND CARIBBEAN ECONOMIC  
ASSOCIATION (LACEA)**  
President, 2001-2003.

**INTER AMERICAN SEMINAR ON ECONOMICS (IASE)**  
Chairman, 1987-2010

**KIEL INSTITUTE OF WORLD ECONOMICS, KIEL-GERMANY**  
Scientific Advisory Council, 2002-present

**TRANSNATIONIONAL RESEARCH CORPORATION**  
Member of the Advisory Board

**KIEL INSTITUTE OF WORLD ECONOMICS, KIEL-GERMANY**  
Visiting Professor, Several times,

CENTRO DE ESTUDIOS PÚBLICOS, SANTIAGO-CHILE. Member  
of the Board.,

## **EDITORIAL**

Co-editor of the Journal for Development Economics, 1991-2005.  
Associate Editor of *the Journal of International Trade and Economic  
Development*, *the Journal of International Financial Markets*,  
*Institutions and Money*, and *Analisis Economico*, *Journal of  
Development Economics*, among other scholarly journals.

## CONSULTANCY

Consultant to a number of multilateral institutions, including the International Monetary Fund, the World Bank, the Inter-American Development Bank, the OECD, the U.S. Agency on International Development.

Consultant to a number of governments, including Costa Rica, Guatemala, Mexico, Argentina, Chile, Colombia, New Zealand, Indonesia, Tanzania and Nicaragua.

Consultant to a several corporations and professional associations.

## EXPERT WITNESS

Expert witness in several cases involving exchange rates, international securities, international taxation, credit events, international investment disputes and other economic and financial issues related to developing and emerging countries. Worked with several international law firms. Details available on request.

### **Expert Testimony Since 2019**

1. January, 2022: Tax Court in Chile. SII vs LMC Chile SpA, Rol, RIT: GR-16-00100-2019; RUC: 19-9-0000481-0; Caratulada: LMC CHILE SPA con SII DGC.
2. January, 2020: International Arbitration. Gramercy Funds Management LLC and Gramercy Peru Holdings LLC v. Republic of Peru, ICSID Case No. UNCT/18/2
3. March, 2019: Arbitration Court in Chile. Commercial Bank Valuation.

## PERSONAL BACKGROUND

Born August 16, 1953, in Santiago, Chile.

U.S. Citizen and Chilean Citizen.

## PUBLICATIONS

### **I. Books and Monographs**

The Order of Liberalization of the External Sector in Developing Countries, Princeton Essays in International Finance No. 156, New Jersey, International Finance Section, Princeton University, December 1984.

Economic Adjustment and Exchange Rates in Developing Countries, (Co-edited with L. Ahamed), Chicago: University of Chicago Press, 1986.

Monetarism and Liberalization: The Chilean Experiment (in collaboration with A. Cox-Edwards), Cambridge, Mass.: Ballinger Publishing Co., 1987.

Named by Choice to its 1987 list of Outstanding Academic Books.

Exchange Rate Misalignment in Developing Countries, Baltimore: Johns Hopkins University Press, 1988.

Debt, Adjustment and Recovery: Latin America's Prospects for Growth and Development (Co-edited with F. Larraín), Oxford: Basil Blackwell, 1989.

Real Exchange Rates, Devaluation and Adjustment: Exchange Rate Policy in Developing Countries, Cambridge, Mass.: MIT Press, 1989.

Best Practices in Trade Policy Reform (Co-author), New York: Oxford University Press, 1991.

The Macroeconomics of Populism in Latin America (Co-edited with R. Dornbusch), Chicago: University of Chicago Press, 1991.

Spanish version published by Fondo de Cultura Economica, Mexico D.F. Mexico, 1992.

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Latin America and the Caribbean a Decade after the Debt Crisis, Latin American and the Caribbean Region of the World Bank, 1993.

Stabilization, Adjustment and Growth (Co-edited with R. Dornbusch), Chicago: University of Chicago Press, 1994.

Capitol Controls, Exchange Rates, and Monetary Policy in the World Economy, S. Edwards (Ed.), Cambridge, New York and Melbourne: Cambridge University Press, 1995.

Crisis and Reform in Latin America: From Despair to Hope, Oxford: Oxford University Press for the World Bank, 1995.

Latin America After Mexico: Quickening the Pace (Co-authored with S.J. Burki), The World Bank, 1996.

Dismantling the Populist State: The Unfinished Revolution in Latin America and the Caribbean (Co-authored with S.J. Burki), The World Bank, 1996.

Crisis and Reform in Latin America: From Despair to Hope, Oxford: University Press, 1995. Spanish version published by EMECE, 1997.

Labor Markets in Latin America: Combining Social Protection with Market Flexibility (Co-edited with N.C. Lustig), The Brookings Institution, 1997.

Inflacion, Estabilizacion y Politica Cambiaria en America Latina (Co-edited with M. Cardenas), Tercer Mundo Editores, 1997.

Mexico 1994: Anatomy of an Emerging-Market Crash (Co-edited with M. Naím), Carnegie Endowment for International Peace, 1997.

Capital Flows and the Emerging Economies, S. Edwards (Ed.), Chicago: University of Chicago Press, 2000.

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Preventing Currency Crises in Emerging Markets (Co-edited with Jeffrey A. Frankel), Chicago: University of Chicago Press, 2002.

Capital Controls and Capital Flows in Emerging Economies: Policies, Practices, and Consequences, Chicago and London: University of Chicago Press, 2007, pp. ix, 688

The Decline of Latin American Economies: Growth, Institutions, and Crises, With Esquivel, Gerardo; Marquez, Graciela. Chicago and London: University of Chicago Press, 2007, pp. viii, 418

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American Default: The untold story of FDR, the Supreme Court and the battle over gold, Princeton University Press, 2018

The Chile Project: The Story of the Chicago Boys and the Downfall of Neoliberalism, Princeton University Press, 2023

## **II. Articles**

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Spanish version in Cuaderno de Economia, 48(0), 1979.

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Reprinted in Development Economics, D. Lal (Ed.), Edward Elgar, 4(0), 1992, 41-71.

“Introduction to Macroeconomic Adjustment and Growth,” (with E. Bacha) in Journal of Development Economics, December 1988.

“The United States and Foreign Competition in Latin America,” in The Changing Role of the United States in the World Economy, M. Feldstein (Ed.), Chicago: University of Chicago Press, 1988, 9-64.

Summary in National Bureau of Economic Research Digest, September 1987.

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“Structural Adjustment in Highly Indebted Countries,” in The Developing Countries' Debt Crisis, J. Sachs (Ed.), Chicago: University of Chicago Press, 1988.

Abridged version in Developing Countries Debt: The NBER Debt Project, J. Sachs (Ed.), Chicago: University of Chicago Press, 1988.

“Commercial Policy, Terms of Trade and the Equilibrium Real Exchange Rate,” in Journal of International Economic Integration, 1988, 1-31.

“Exchange Rate Misalignment in Developing Countries,” in World Bank Research Observer, 4(1), January 1989, 3-21.

Reprinted in Approaches to Exchange Rate Policy, Washington, D.C., International Monetary Fund, 1994.

“Tariffs, Capital Controls, and Equilibrium Real Exchange Rates,” in Canadian Journal of Economics, 22(0), February 1989, 79-92.

“Solving the Debt Crisis and Restoring Developing Countries Credit Worthiness: Comment,” in Carnegie-Rochester Conference Series on Public Policy (Supplement to the Journal of Monetary Economics), K. Brunner and A. Meltzer (Eds.), 30(0), Spring 1989, 115-127.

“Exchange Controls, Devaluations and Real Exchange Rates: The Latin American Experience,” in Economic Development and Cultural Change, 37(3), April 1989, 457-494.

“Debt Crisis, Trade Liberalization, Structural Adjustment and Growth: Some Policy Considerations,” in Contemporary Policy Issues, 7(3), July 1989, 30-41.

“Temporary Terms of Trade Disturbances, the Real Exchange Rates and the Current Account,” in Economica, 56(223), August 1989, 343-357.

“The International Monetary Fund and the Developing Countries: A Critical Evaluation,” in Carnegie-Rochester Conference Series on Public Policy, K. Brunner and A. Meltzer (Eds.), 31(0), Fall 1989, 7-68.

Spanish version in EI Trimestre Económico, 57(227), July-September 1990, 611-663.

“What Does the International Monetary Fund Really Do? Reply,” in Carnegie Rochester Conference Series on Public Policy, 31(0), Autumn 1989, 77-81.

“The Price of Postponed Adjustment,” (with P.J. Montiel) in Finance and Development, 26(3), September 1989, 34-37.

“Devaluation Crises and the Macroeconomic Consequences of Postponed Adjustment in Developing Countries,” (with P. Montiel) in International Monetary Fund Staff Papers, 36(4), December 1989, 875-903.

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### Appendix C - Macroeconomic Projections

Year	Solow Model Real GNP Projection	EOM Real GNP Projection with Income Adjustment	EOM Real GNP Projection without Income Adjustment	World Bank Population Projection	Commonwealth Fiscal Plan Population Projection
2021	\$ 5,731,000,000	\$ 6,031,715,926	\$ 5,760,878,829	3,263,584	3,322,863
2022	\$ 5,921,046,484	\$ 6,346,253,694	\$ 5,912,790,676	3,268,675	3,278,624
2023	\$ 5,958,691,686	\$ 6,382,301,815	\$ 5,967,676,184	3,276,550	3,241,305
2024	\$ 5,978,049,951	\$ 6,277,984,461	\$ 5,927,451,827	3,282,839	3,207,742
2025	\$ 6,015,254,601	\$ 6,212,156,731	\$ 5,927,833,098	3,286,781	3,176,643
2026	\$ 6,063,717,082	\$ 6,182,533,021	\$ 5,946,563,741	3,287,874	3,152,073
2027	\$ 6,164,649,169	\$ 6,224,998,970	\$ 6,004,570,633	3,285,947	3,137,306
2028	\$ 6,249,661,915	\$ 6,252,491,743	\$ 6,033,336,186	3,280,893	3,121,597
2029	\$ 6,304,364,450	\$ 6,246,445,326	\$ 6,027,947,612	3,270,699	3,103,796
2030	\$ 6,335,446,470	\$ 6,225,645,533	\$ 6,008,053,246	3,254,590	3,081,449
2031	\$ 6,357,071,564	\$ 6,214,802,594	\$ 5,997,839,019	3,233,138	3,055,271
2032	\$ 6,348,183,759	\$ 6,169,850,292	\$ 5,953,869,873	3,207,905	3,027,073
2033	\$ 6,332,696,047	\$ 6,126,801,407	\$ 5,911,662,684	3,181,722	2,999,983
2034	\$ 6,314,360,046	\$ 6,078,131,804	\$ 5,863,973,453	3,155,170	2,973,390
2035	\$ 6,301,058,421	\$ 6,028,061,082	\$ 5,814,983,655	3,128,540	2,946,111
2036	\$ 6,262,618,285	\$ 5,943,077,525	\$ 5,731,494,272	3,101,943	2,915,518
2037	\$ 6,241,561,096	\$ 5,882,661,605	\$ 5,672,307,517	3,075,307	2,883,783
2038	\$ 6,232,966,608	\$ 5,834,253,170	\$ 5,625,242,754	3,048,726	2,851,037
2039	\$ 6,233,736,962	\$ 5,794,804,109	\$ 5,587,315,795	3,022,090	2,818,131
2040	\$ 6,240,932,246	\$ 5,762,358,649	\$ 5,556,545,289	2,995,465	2,786,247
2041	\$ 6,287,055,954	\$ 5,763,519,291	\$ 5,557,554,115	2,968,675	2,755,326
2042	\$ 6,256,686,937	\$ 5,702,828,704	\$ 5,501,183,077	2,941,766	2,724,321
2043	\$ 6,267,546,872	\$ 5,676,938,933	\$ 5,477,108,324	2,914,499	2,693,899
2044	\$ 6,277,344,168	\$ 5,652,742,505	\$ 5,454,676,489	2,886,902	2,664,685
2045	\$ 6,285,954,364	\$ 5,630,088,632	\$ 5,433,729,428	2,859,049	2,637,420
2046	\$ 6,296,058,522	\$ 5,609,418,069	\$ 5,414,703,337	2,830,964	2,611,638
2047	\$ 6,317,117,134	\$ 5,595,861,705	\$ 5,402,407,844	2,802,708	2,587,219
2048	\$ 6,335,835,804	\$ 5,578,576,538	\$ 5,386,704,991	2,774,253	2,564,228
2049	\$ 6,358,512,113	\$ 5,562,638,765	\$ 5,372,304,326	2,745,694	2,541,952
2050	\$ 6,383,837,227	\$ 5,549,656,487	\$ 5,360,776,403	2,716,734	2,519,706
2051	\$ 6,405,502,157	\$ 5,538,018,851	\$ 5,350,534,622	2,689,133	2,498,791

**Note:**

[1] Real GNP is in 1954 U.S. dollars.

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[A] Expert Report of Sebastian Edwards.

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